CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

PROCEEDINGS Papers Become Separates—Society News

Big Meters Installed on Delaware Aqueduct—Gress

Attend 1950 Annual Meeting New York, January 18-20

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

SHERATON HOTEL

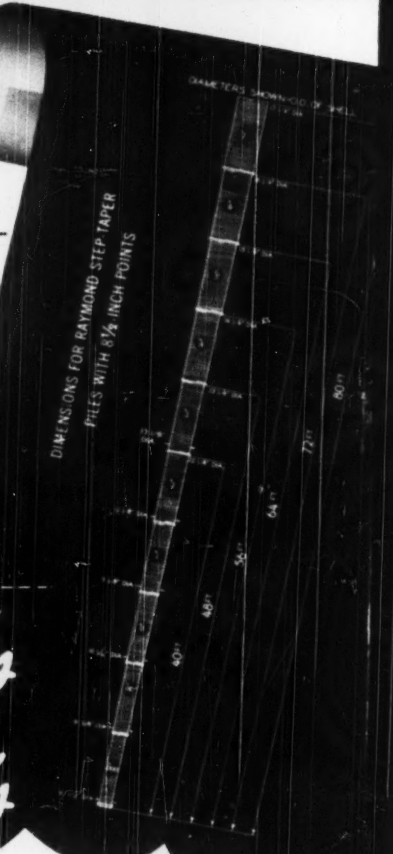
Raymond MAKES 5 TYPES OF CONCRETE PILES

1. STANDARD . . . 2. STEP-TAPER . . . 3. PIPE STEP-TAPER

4. COMPOSITE . . . 5. GOW CAISSONS

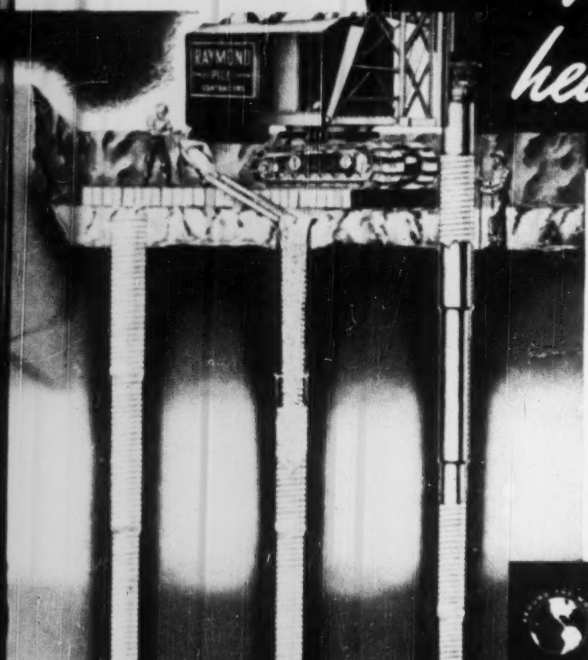
Raymond installs every type of pile: cast-in-place concrete, precast concrete, steel pipe, wood and H-beam. Raymond operations include underpinning, borings and soil investigations, waterfront construction and harbor and river improvements, also cement mortar lining of pipes by the Centriline Corporation, a Raymond Subsidiary.

At left, completed Step-Taper Pile Center, filling the permanent steel shell with concrete after internal inspection. Right, driving the pile with rigid core.


DIAMETERS SHOWN O.D. OF SHELL
DIMENSIONS FOR RAYMOND STEP-TAPER PILES WITH 8½ INCH POINTS
40 FT
48 FT
56 FT
64 FT
72 FT
80 FT

2. STEP-TAPER PILES

FOR *long lengths* WITH *heavy loads*



Raymond Step-Taper Concrete Piles driven with rigid steel cores and heavy hammers are designed to develop high load-carrying capacities at depths to 80 feet. The permanent steel shell maintains the resistance developed during driving. After the shell is inspected internally, it is filled with concrete and cut off at the specified elevation.

You are invited to discuss with our engineers the efficiencies and savings made possible by Raymond's exclusive, original concrete pile designs.

◀ RAYMOND PILES MAINTAIN DRIVING RESISTANCE

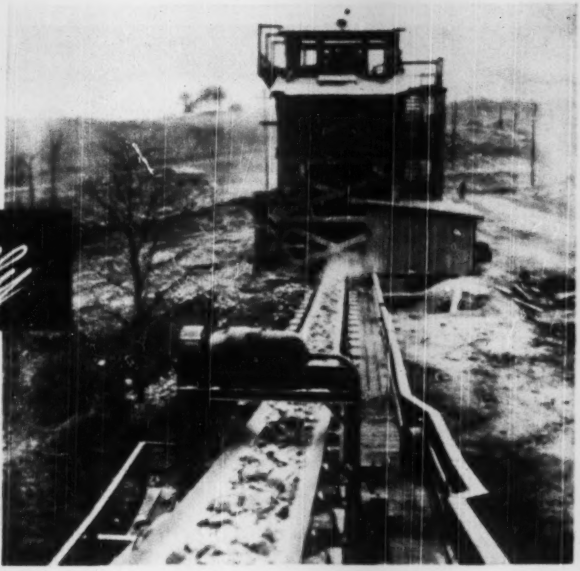
Raymond CONCRETE PILE CO.

140 CEDAR ST., NEW YORK 6, N. Y.

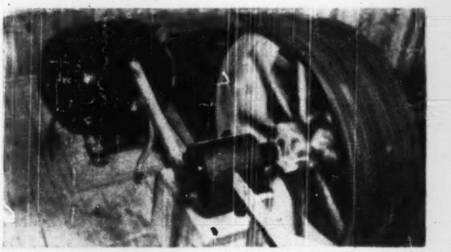
BRANCH OFFICES: Boston, Syracuse, Philadelphia, Baltimore, Washington, Pittsburgh, Atlanta, Miami, Houston, Kansas City, St. Louis, Cleveland, Chicago, Detroit, Salt Lake City, Portland, San Francisco, Oakland, Los Angeles and principal cities in Latin America.

turning granite into sand . . .

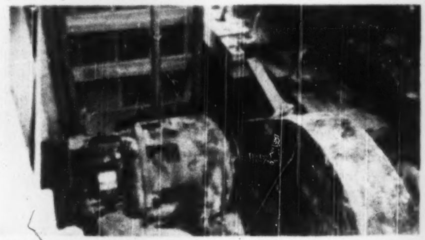
. . . Electrically



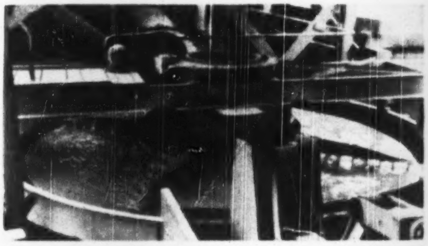
Rock coming from secondary crusher is carried on conveyor driven by a 50-hp G-E gear-motor



Crushed rock is reduced to sand in Marcy rod mill made by The Mine & Smelter Supply Co., Denver, Colo. Drive is a 350-hp G-E synchronous motor



50-hp G-E motor powers conveyor belt hauling material to hopper at top of cement mill



Dorr classifier, for washing sand clean and removing dirt and fines, is powered by a 3-hp G-E gear-motor

Aggregate Plant at Clark Hill Depends on G-E Driven Equipment To Maintain High-Speed Production

It takes rugged, dependable equipment—with rugged, dependable drive—to turn out 450 tons of aggregate per hour, 24 hours a day, as the high-speed plant at Clark Hill is doing. That's why Allstates Constructors, Inc.—a team of six contractors led by Walsh Construction Co.—is relying on *electric drive* to keep the crushers, rod mill, conveyors, and sand classifiers on-the-job, all the time.

Contractors and machinery manufacturers alike are finding that the greater dependability of electric drive means *greater profits.* And when they use G-E drive, expert engineering assistance in application, installation, and service is always available to them—wherever the job may be.

Ask him Today!

Whether you buy or build construction equipment, your G-E representative can show you how to do a better job—at lower cost—by complete electrification. Write him now, and he'll call on you at your convenience.

Electrified Construction

BETTER PRODUCT
LOWER COST

GENERAL ELECTRIC

664-7

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Savannah, Georgia	1870
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Kokomo, Indiana	1874
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Grand Rapids, Michigan	1875
Indianapolis, Indiana	1878
Lockport, New York	1879
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North Manchester, Indiana	1881
Racine, Wisconsin	1883
Appleton, Wisconsin	1883
Oshkosh, Wisconsin	1884
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Minneapolis, Minnesota	1886
St. Paul, Minnesota	1886
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Superior, Wisconsin	1891
Salt Lake City, Utah	1892
Atlanta, Georgia	1895
Augusta, Georgia	1895
Springfield, Massachusetts	1895
Bangor, Maine	1896

Here's an underground operation in 36 cities that proves the durability of *CONCRETE PIPE*

For more than 50 years concrete pipe sewers have served continuously and faithfully in the thirty-six American cities listed above.

In fact this successful underground operation has been going on for 60, 70, 80, 100 or more years, in more than three fourths of these cities. Such long service records offer ample proof of the durability of concrete pipe for sewers.

Durability and long life are but two of the outstanding qualities of concrete pipe for sewer use. The others are:

- A uniformly dense structure with clean, even joints that can be made watertight—thus assuring minimum infiltration and leakage.
- A smooth interior finish that resists the wearing action of suspended abrasive matter and which provides maximum hydraulic capacity.
- Unusual strength that resists severe impact and sustains heavy overburdens.
- Unusual economy due to its moderate first cost, its long service life and its low maintenance cost. These three factors result in *low-annual-cost* sewer service—and that is the only true measure of economy in pipe line operation.

AMERICAN CONCRETE PIPE ASSOCIATION
228 NORTH LA SALLE STREET, CHICAGO 1, ILLINOIS

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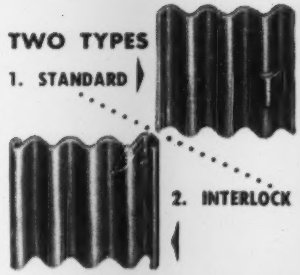
CORR-PLATE

CORR-PLATE* ON THE JOB!

CORR-PLATE on the Job! Sewer Job at Fort Wayne, Indiana, crossing the St. Mary's River, used 8 Gauge, Standard Section, 20 Foot Lengths.

TWO TYPES



Always on the job . . . because CORR-PLATE is easily driven by hand or sheeting hammer. Easily pulled, transported and driven over and over again *without distortion!*

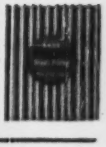
Always easy to handle . . . because CORR-PLATE is 25% lighter than comparable materials, rigid, CORR-PLATE *nests.*

Always economical . . . cuts driving and handling costs an *average* 30%.

Always preferred . . . because CORR-PLATE is *stronger, lighter, longer lasting!*

***STRONGEST* per pound weight**

Write for CORR-PLATE Catalog CE-1, TODAY — shows how CORR-PLATE is used on your job, gives complete specifications for Standard and Interlock Sections. All types of construction shown — all accessories and specials listed. *(Contractors, Engineers, Executives — write for your copy today.)*



caine CORR-PLATE piling Company

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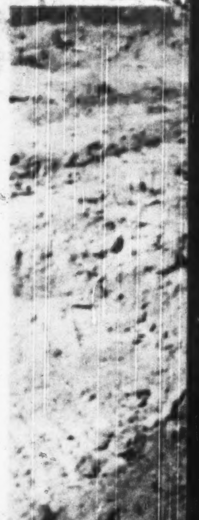


First in the field in every way, the International TD-24 is the only crawler that gives you these features:

- *Eight Speeds*, forward and reverse—an ideal speed for every phase of operation.
- *Synchromesh Transmission*, for easy on-the-go shifting, cuts waste shifting time almost completely out of your cycle.
- *Planet Power Drive* gives you power on both tracks in a turn for magic maneuverability *plus* an instant shift up or down one speed in both high and low range.
- *Finger-Tip Hydraulic Steering* control erases operator fatigue.
- *140 Drawbar Horsepower* gives you more working horsepower than any other crawler.

No other crawler tractor has any of these profit-building features that shrink your costs of operation. Like every operator who has applied the seat of his pants to the comfortable cushion of the TD-24, you too will say, "It's a dirt-moving demon—no other crawler can compare with it."

See your International Industrial Power Distributor now and get the champion crawler of them all—the International TD-24—to work for you.

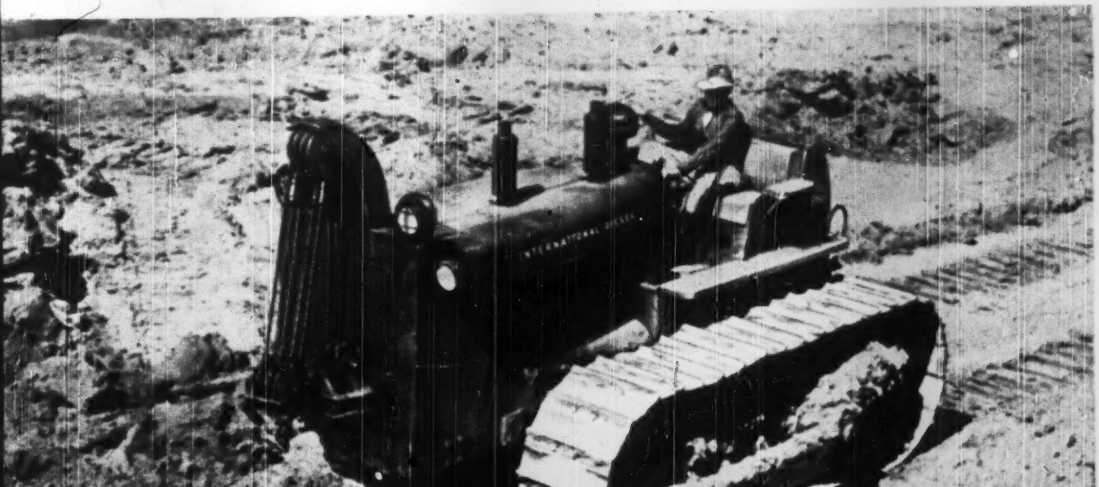
INTERNATIONAL HARVESTER COMPANY · Chicago

Hot news from the "grapevine": J. W. Mosely, contractor on the Big Grapevine Dam project near Dallas, Texas, says of his International TD-24's, "In my estimation, the International TD-24 crawler tractor is the new champion of crawlers."

INTERNATIONAL
INDUSTRIAL POWER

INTERNATIONAL
HARVESTER

CHAMPION OF 'EM ALL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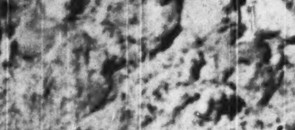
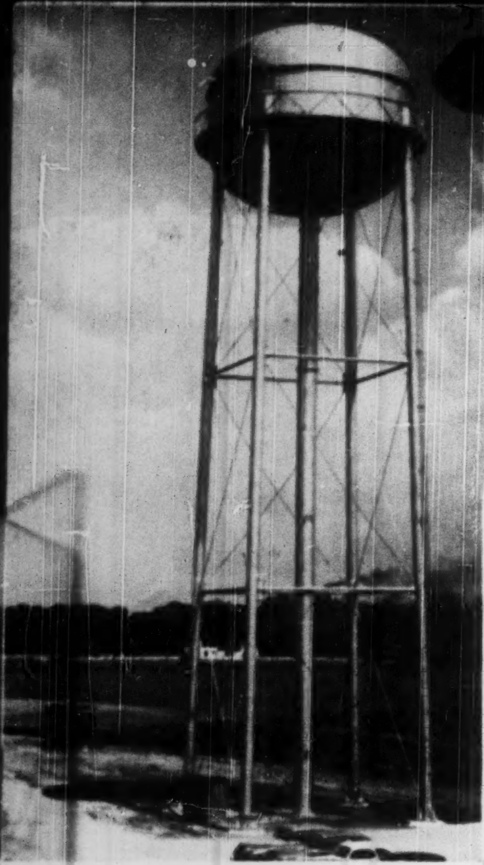
CRAWLER TRACTORS • WHEEL TRACTORS • DIESEL ENGINES • POWER UNITS





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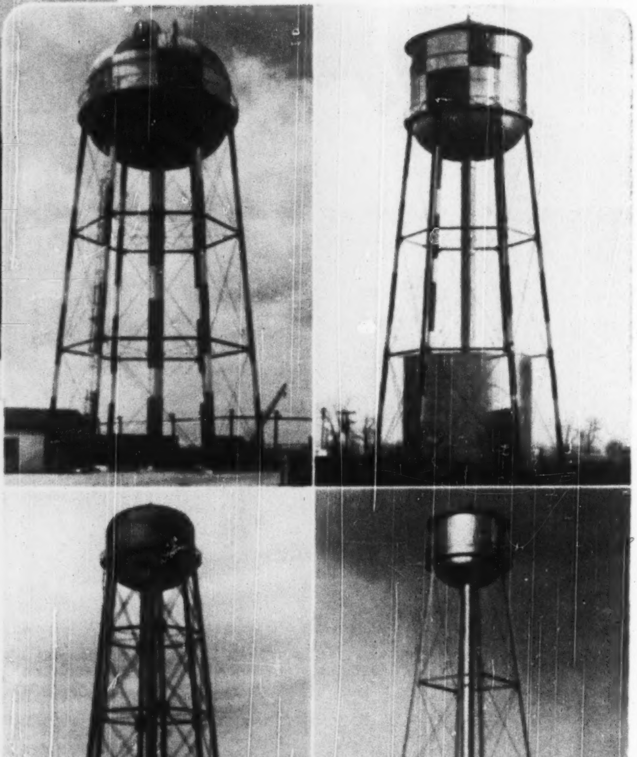

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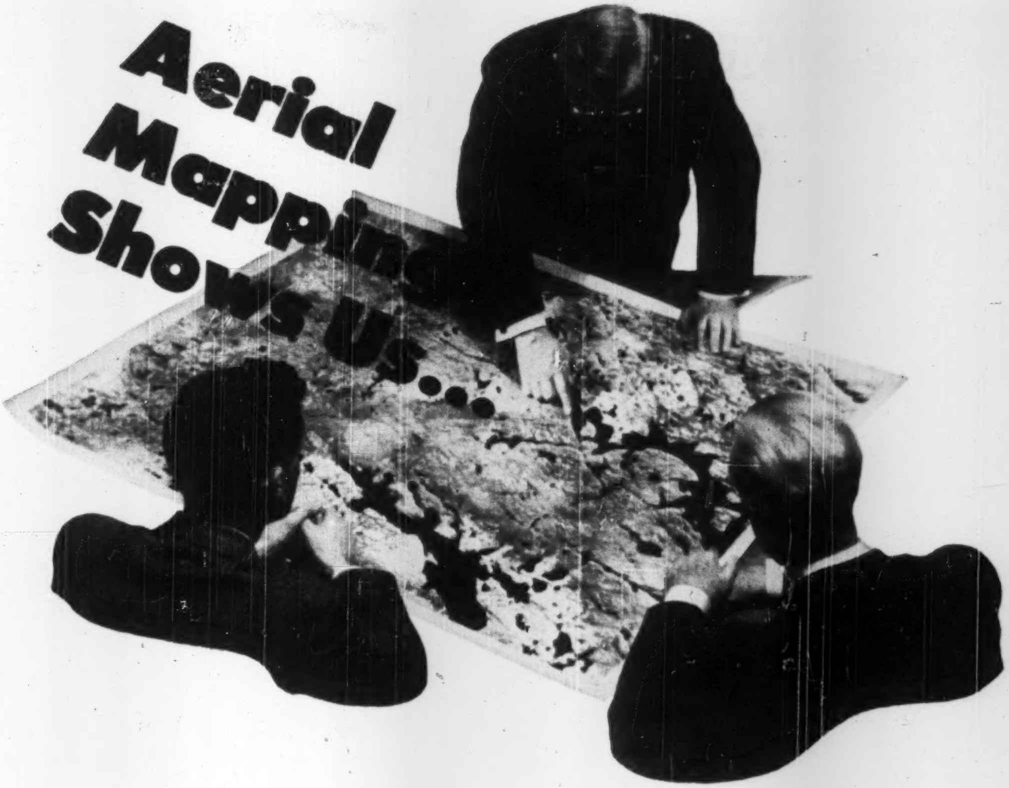
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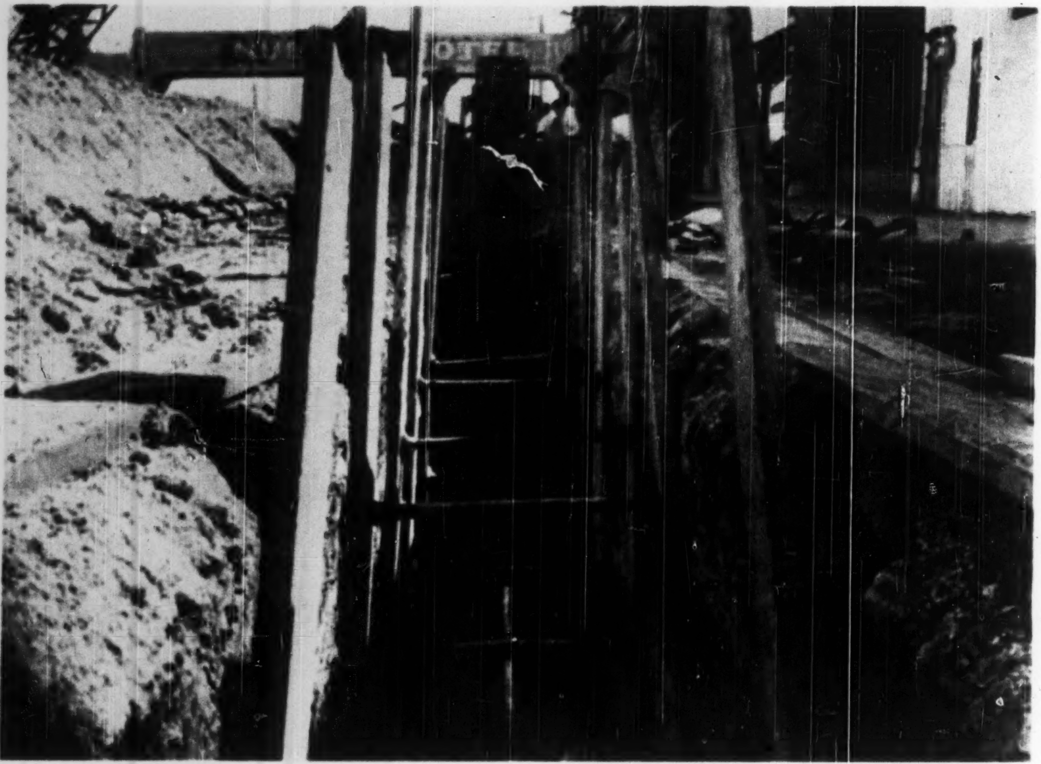

"DRY RESULTS OR NO PAY"

On that basis, T. H. Lee, Contractor, San Antonio, Texas, gave MORETRENCH an order to predrain his Water Street sewer excavation in Corpus Christi.

Past wellpoint failures had convinced many contractors and engineers that wellpoints would not work in the fine sand, silty clay and blue plastic mud found on this old beach front where ground water is four feet below street level.

Let's let our demonstrator's reports finish the story:

Mon. "Started pumping at 6 P.M."

Tues. "Dug a test hole this morning — water below subgrade."

Wed. "Started excavation with digging machine. Dry cut. Vertical 10-foot embankment remained in excellent shape with skeleton sheeting."

MORETRENCH RESULTS *ALWAYS* PAY

— in time and money saved!

See for yourself on your next wet job.

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Revolutionizes Black Top Salvage Jobs

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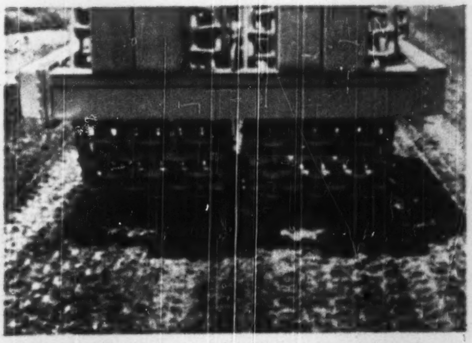
1. Black top is scarified by motor grader pulling Grid Roller.

2. Scarified black top is pulverized to a maximum of small "fines" by Grid Roller.

3. Pulverized black top is windrowed—road bed cleaned by motor grader—compacted by Grid Roller.

4. Windrow is spread and oil applied, material mixed and relaid and then compacted by Grid Roller. Now ready for seal coat.

HOW IT SAVES TIME AND MATERIAL



Salvaged Black Top compacted in place and ready for seal coat

1. In ONE day ONE man with motor grader and Grid Roller can salvage and prepare ONE MILE of black top road for oiling.

2. Grid Roller produces greater abundance of FINE MATERIAL.

3. Oil usage reduced up to ¾ of a gallon per cubic yard—on one county road job a savings of $343 per mile in oil was effected.

4. Grid Roller salvages all types of black top material. NO NEED TO HAUL AWAY OLD MATERIAL.

Sold exclusively by your "CATERPILLAR" DEALER. CONSULT HIM FOR FACTS, FIGURES, LITERATURE.

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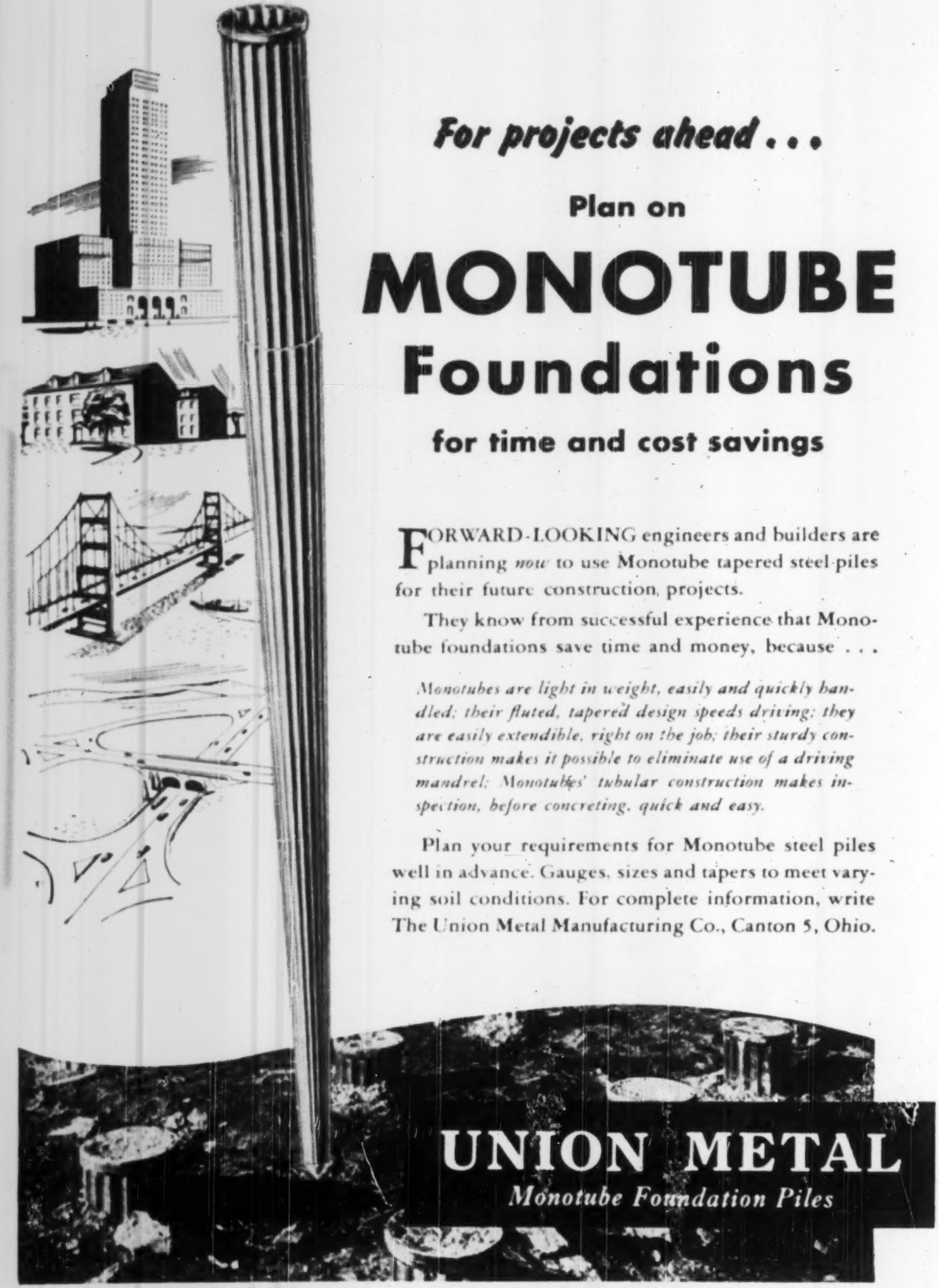

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for time and cost savings

FORWARD-LOOKING engineers and builders are planning *now* to use Monotube tapered steel piles for their future construction projects.

They know from successful experience that Monotube foundations save time and money, because . . .

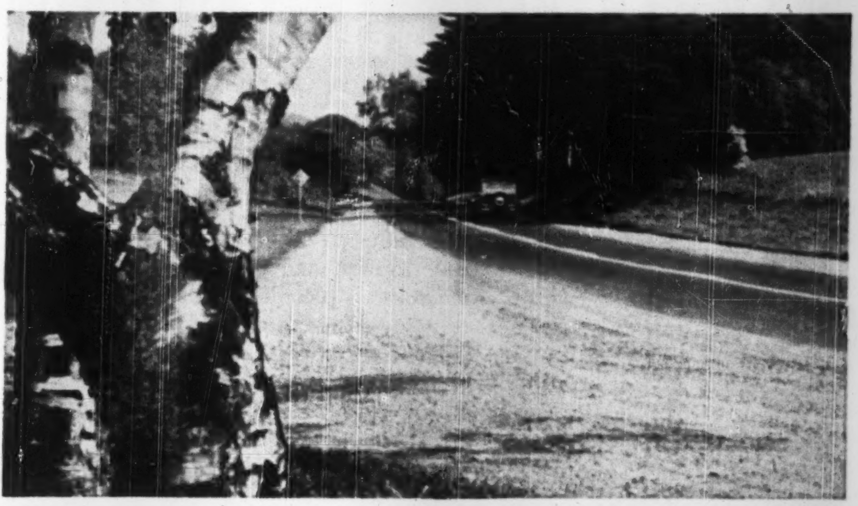
Monotubes are light in weight, easily and quickly handled; their fluted, tapered design speeds driving; they are easily extendible, right on the job; their sturdy construction makes it possible to eliminate use of a driving mandrel; Monotubes' tubular construction makes inspection, before concreting, quick and easy.

Plan your requirements for Monotube steel piles well in advance. Gauges, sizes and tapers to meet varying soil conditions. For complete information, write The Union Metal Manufacturing Co., Canton 5, Ohio.

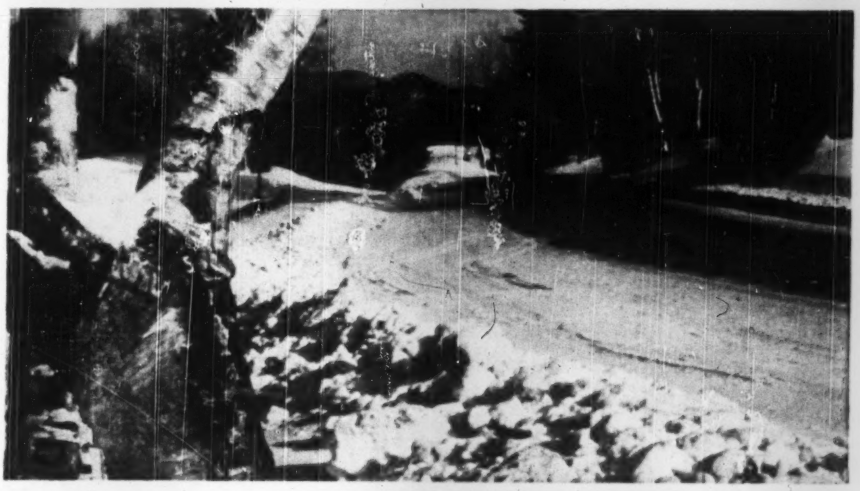
UNION METAL

Monotube Foundation Piles

FOR YEAR 'ROUND ROAD SATISFACTION



Roads built with TARVIA* road tar are restful on the eyes and add to the attractiveness of any landscape. Even under hot summer suns, they are glare-free—take the strain out of driving.



Roads built with TARVIA road tar are not affected by calcium chloride or sodium chloride. Their black surfaces absorb heat. Result? Roads easier to keep open—easier and safer to ride on.

The slightly granular, "tractionized" surface of TARVIA road tar pavement gives tires a firm tread-hold for safer driving.

Barrett's 46 years of experience in road building, maintenance and repair is yours for the asking. ***Ask the Barrett field man.***

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THE MEMBERSHIP OF A C.I.P. Century Club now has

The Cast Iron Pipe Century Club is probably the most unique club in the world. Membership is limited to municipal, or privately-owned, gas and water supply systems having cast iron mains in service for a century or more.

Although the Club is formally established, there are no dues, no regular meetings, and no obligations other than to inform the Recording Secretary if and

[illegible]

CAST IRON PIPE

DISTINGUISHED CLUB...
29 Members!

when the qualifying gas or water main is taken out of service, or, sold for re-use.

In spite of the unique requirement for membership, the Club roster grows, year by year. And why not, when answers to a questionnaire, mailed to gas officials in 43 large cities, show that *original* cast iron mains are still in service in 29 of the cities. And a survey sponsored by three water works associations, indicates that 96% of all 6-inch and larger cast iron water mains ever laid in 25 representative cities are still in service.

If your records show a cast iron main in service, laid a century or more ago, the Club invites you to send for a handsome framed Certificate of Honorary Membership. Address Thomas F. Wolfe, Recording Secretary, Cast Iron Pipe Century Club, Peoples Gas Bldg., Chicago 3, Illinois.

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SERVES FOR CENTURIES

Sub-Zero Concreting!

ECONOMICAL 'INCOR' WINTER SCHEDULES SPEED CONSTRUCTION OF 'NYTAL'S WELL-DESIGNED TALC MILL AND MINE SHAFT

OUTSTANDING alike for quality construction and quality production, the new plant of GOUVERNEUR TALC COMPANY, INC., at Balmat, N. Y., is a dependable source of talc supply for paint, paper, rubber, ceramic and other industries—rated capacity 60,000 tons a year.

Buildings and silos are well designed and staunchly built, and the 600-ft. mine shaft of strong, durable concrete gives access to well-engineered sub-surface operations. Much of the construction work was done last winter, and 'INCOR'* 24-HOUR CEMENT helped maintain economical schedules.

The mine shaft's 12-inch lining was concreted on a weekly cycle: Drilling, blasting, excavating and setting forms Monday through Saturday morning . . . concreting Saturday afternoon, average pour 24 ft. . . . stripping Sunday P.M. Water and aggregates heated . . . concrete averaged 60-70 degrees when placed . . . work went ahead steadily, with outside air temperatures as low as 38° below zero.

Quality concrete throughout, even under adverse conditions.

*Reg. U. S. Pat. Off.

Dependable 'Incor' high early strength cut heat-protection costs, maintained economical schedules, in concreting 'Nytal' talc plant—buildings, silos, mine shaft. Neat-line excavation of shaft is 8'4" x 14'5", inside concrete lines 6'4" x 12'5", providing a 12" lining—depth, 600 ft.

Owner: **GOUVERNEUR TALC COMPANY, INC.,** Balmat, N. Y.
Subsidiary of **R. T. VANDERBILT CO., INC.,** New York City
Contractor, Buildings & Silos: **JAMES STEWART & CO., INC.,** N.Y.
Consulting Engineers: **STROBEL & SALZMAN,** New York
Engineer and Contractor, Mine Shaft:
UNDERPINNING & FOUNDATION CO. INC., New York

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'INCOR' HIGH EARLY STRENGTH PORTLAND CEMENT
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JANUARY 1950
VOLUME 20 NUMBER 1

CIVIL ENGINEERING

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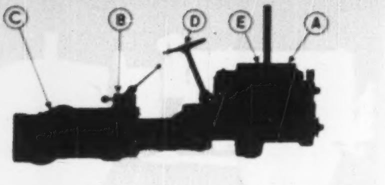

DORENA DAM in Oregon, begun in May, 1947, was considered a big 3½-year project. Good organization* plus job-steady "Cat" DW10s were two important reasons why completion time was shortened by almost 12 months.

Ten DW10 Tractors with No. 10 Scrapers spearheaded the "Caterpillar" fleet. Extended sides on the Scrapers enabled each to carry 11 borrow-pit yards. Averaging about 6 trips each on hauls over 4000 feet . . . including 1500 feet of adverse grade to crest of dam . . . these units moved some 570 cubic yards per hour – for a total of about 10,250 yards per 18-hour day. Two D8s served as pushing units in the pits . . . load time was less than a minute. Four additional DW10s worked on the fill, equipped with 'dozers and pneumatic-tired tampers.

These records tell a story of speed, volume—and owner-operator satisfaction. Project Manager A. H. Steiner says: "These units are unbeatable. Among their biggest features are their easy loading and ease of operation. Our boys work nine hours a day and hardly know when lunch hour comes around."

Profit-making speed and volume, little or no interrupting down time over long periods of operation, complete satisfaction – are the "end results" "Caterpillar" owners expect and invariably *get*.

**Under the name of The Dorena Construction Co., this project was put through with the co-ordinated facilities of: G. F. Atkinson Co., Bressi & Bevanda Construction, Inc., W. E. Kier Construction Co., and A. Teichert & Son, Inc.*

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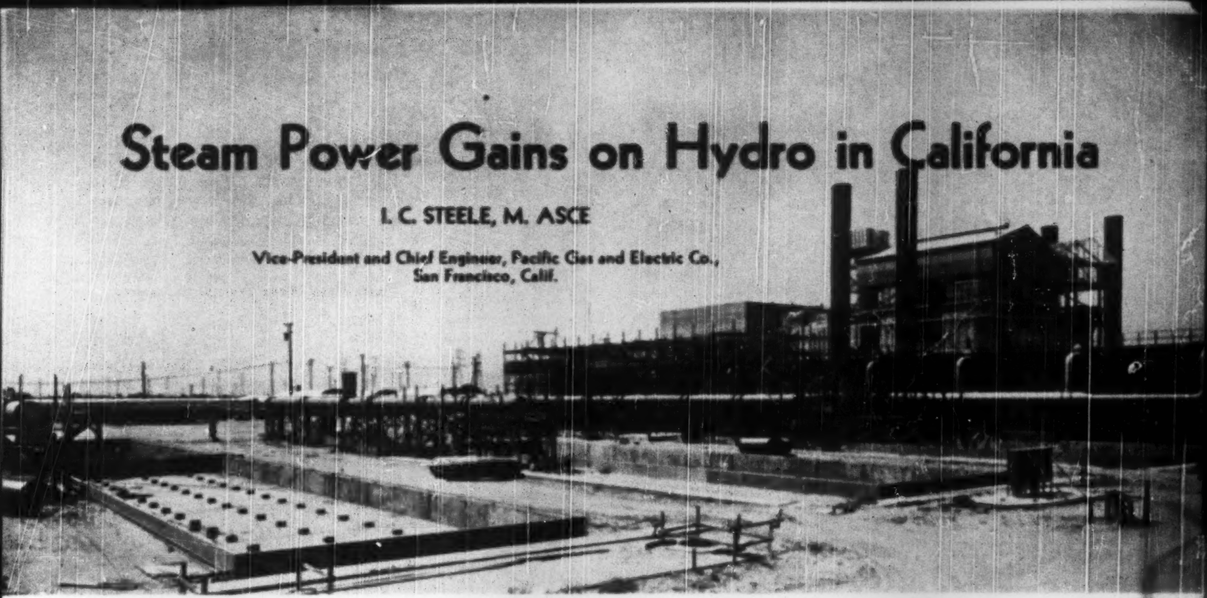
SEND FOR LATEST BOOKLET
"The 'Caterpillar' DW10 in Action"

Steam Power Gains on Hydro in California

I. C. STEELE, M. ASCE

Vice-President and Chief Engineer, Pacific Gas and Electric Co.,
San Francisco, Calif.



FOUR STEAM PLANTS under construction by Pacific Gas & Electric Co. will add one million kilowatts to its generating capacity at cost of about $162,700,000. One of these is Kern Plant about three miles west of Bakersfield, Calif. Cooling tower foundations for second unit are seen in foreground. Turbine and control rooms are in square concrete building just visible above cooling tower structures and to left of boiler units.

Pacific Gas and Electric Co. Constructs Million-Kilowatt Turbo Generators

MORE THAN four billion dollars was spent by privately financed electric power companies in the United States between 1945 and 1948. Another five billion is to be spent by these power companies in the following three years. As a part of its 600-million-dollar postwar construction program, the Pacific Gas and Electric Co. in northern and central California is adding a million kilowatts of basic steam power to raise its dependable capacity to 2,700,000 kw. In this article, based on a paper presented at the San Diego Conference of Local Sections of ASCE, Mr. Steele points out that since California has few remaining hydroelectric sites that can be economically developed, steam power is moving from a seasonal peak position in the annual load curve into the base. Oil and surplus natural gas compete with each other as fuel, with gas presently having the edge at a price of about 17 cents per million Btu, or the equivalent of about 95 cents per barrel of oil f.o.b. refinery.

SERVING the major part of northern and central California from Redding south to Bakersfield, and from Nevada to the Coast, the Pacific Gas and Electric system covers an area about 500 miles long and 200 miles wide. Power generated at 58 hydroelectric and 15 steam-electric plants is carried to load centers by transmission lines which have an aggregate length of over 9,000 miles and operate at voltages ranging from 60,000 to 230,000. The dependable dry-year capacity of the company's present installations is 1,893,000 kw, of which 68,000 kw has just been added. It is estimated that if dry-year conditions existed at the time of the 1949 peak (July 27) there would have been available from other sources, principally from the Central Valley Project and the Southern California Edison Co., about 600,000 kw. The 1949 peak was 2,302,000 kw, leaving a margin of about 125,000 kw of dependable power. In 1940 the peak was 1,126,000 kw. The peak was more than doubled in 9 years.

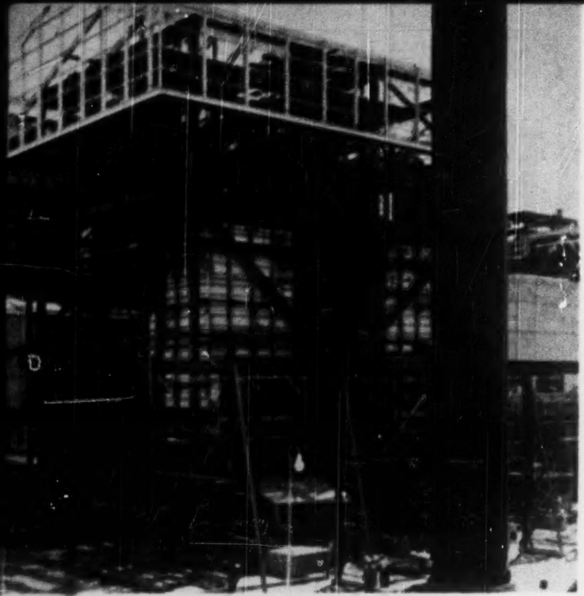
Population Growth Increased Load

This growth of electric load is occasioned by the tremendous increase in population and industrial activity in the state. Estimates show that during the period 1940 to 1949 the population of the Pacific Gas & Electric Co. territory increased nearly 51 percent and that of the whole state 49 percent.

In the postwar period new hydroelectric and steam electric generating capacity totaling 1,300,000 kw is being built by the Company. Another 300,000 kw is being installed at Shasta and Keswick Dams of the Central Valley Project, making a total of over 1½ million kilowatts which is being added in northern and central California, or 1¼ times the total prewar power demand of this area. In this six-year postwar period we are adding as much generating capacity as was built during the previous 65 years by this company and its predecessor and acquired companies. Measured in money, the company's postwar construction program, including its Gas Department expenditures, will total more than 600 million dollars. One million kw, or 77 percent of this 1,300,000 kw of new postwar generating capacity, is being obtained from steam plants.

Steam Plants Prove Economical

During the early years of the company, when most of the power was generated in hydroelectric plants, the principal function of the steam plant was for standby use in the event of power failure, and to supplement hydro during peak hours. The more recent trend has been toward the use of steam power to carry large blocks of steady load. Also many of the favorable hydroelectric sites have been developed and a limited number of sites now remain which can be eco-



SECOND UNIT being added to Kern Plant at cost of about $13,100,000 consists of two boilers and one turbine of 100,000-kw capacity. First unit, of 75,000-kw capacity, also contains two boilers (in background at left in this view). Enclosure between boilers is temporary and protects firing aisle until boilers for second unit are completed.

nomically developed. Therefore the movement toward the construction of steam plant capacity is destined to become greater in future years. Ten years ago the steam plant capacity of the company represented 30 percent of its total installed capacity. Today it is 42 percent, and at the end of the present program, that is, at the end of 1951, it will approximate 54 percent of the company's total generating capacity.

Four Steam Plants Under Construction

As part of the present building program the company is constructing four steam-electric plants. In order of construction progress these are located at Kern, near Bakersfield, 175,000 kw; Hunters Point in San Francisco, 200,000 kw; Moss Landing on Monterey Bay, 300,000 kw; and Contra Costa, near Antioch, 300,000 kw.

In selecting a site for a steam-electric plant, certain requirements should be met if possible. The site should be near a load center to avoid long and costly transmission lines; it should be where fuel can be delivered at reasonable cost; and it should have an adequate supply of cooling water, preferably obtained from a large body, such as a bay or river. In the absence of a suitable water supply, recourse must be had to the less efficient cooling towers. Transportation facilities should be available for bringing in construction materials. A suitable supply of fresh water for boiler make-up and domestic purposes is necessary. The land should be cheap and provide a good foundation on which to build.

We have been unable to locate and obtain a site for any of these four plants that meets all of these ideal conditions. One or more compromises in each instance have been unavoidable.

Plants Have Many Features in Common

These four projects have many features in common, the principal differences being those made necessary by local conditions. The plant buildings comprise a turbine room, auxiliary bay and control room. Boilers are of the semi-outdoor type. The stacks are self-supporting, resting on foundations at ground level. All structures are designed for a seismic factor of 0.2 g. This factor may seem high but it is believed to be justified because of the importance of providing a dependable power supply, especially during periods of emergency. For reasons of dependability, each main turbine has two boilers and a separate "house unit" to provide an independent source of power for the plant auxiliaries.

The turbine generator units are large, all rated at about 100,000 kw, except Kern Unit No. 1 which is 75,000 kw. All rotate at 3,600 rpm except the two Kern units, which operate at 1,800 rpm. Since high-speed turbines tend to create undesirable vibrations, the main units are supported on massive concrete pedestals which are entirely isolated from the building. The house units, being smaller, are not so isolated.

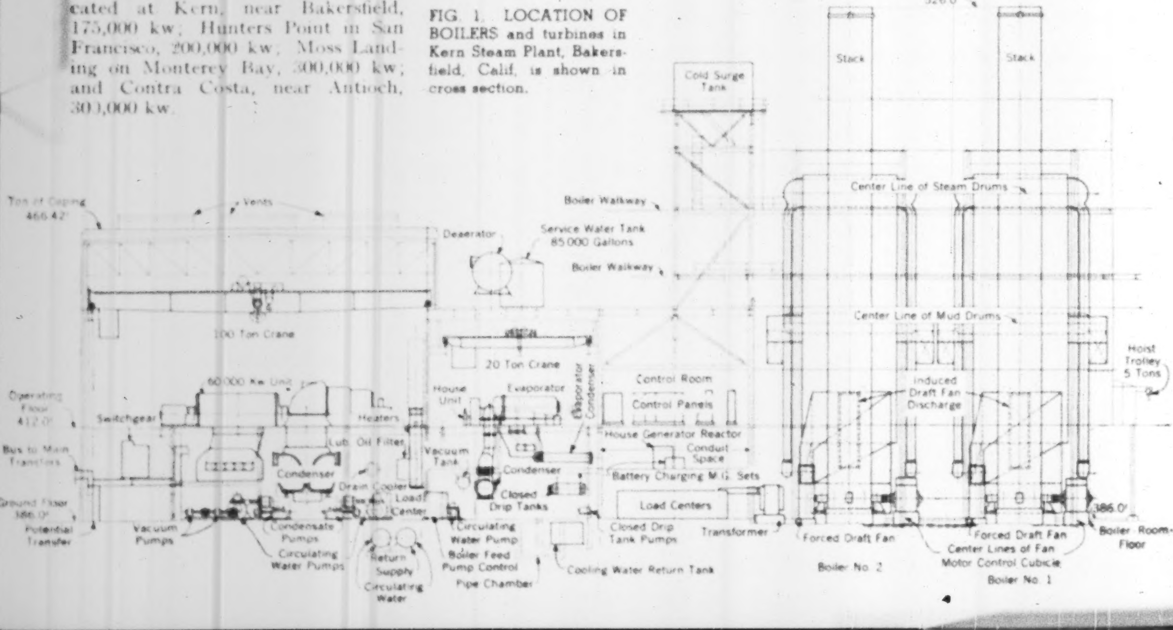
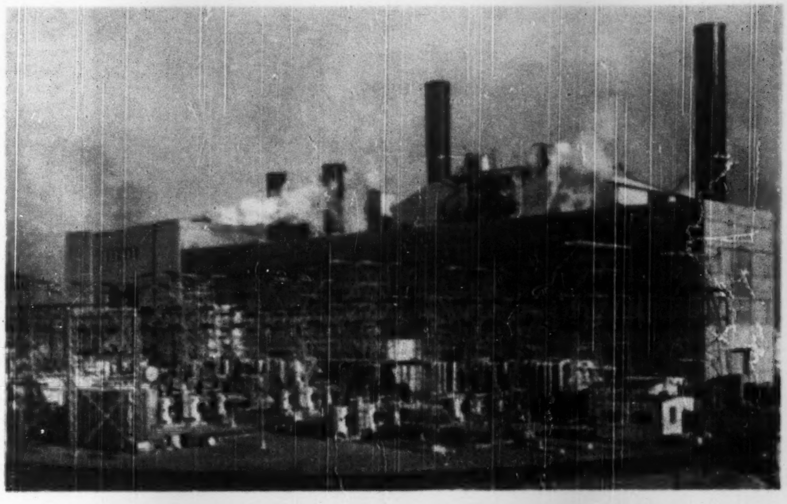


FIG. 1. LOCATION OF **BOILERS and turbines in Kern Steam Plant, Bakersfield, Calif. is shown in cross section.**

Top of Coping 466.42'
Vents
100 Ton Crane
60,000 Kw Unit
Operating Floor 412.0'
Switchgear
Heaters
Lub. Oil Filter
Bus to Main Transfers
Condenser
Drain Cooler
Ground Floor 386.0'
Potential Transfer
Vacuum Pumps
Condensate Pumps
Circulating Water Pumps
Return
Supply
Circulating Water
Load Center
Deaerator
Service Water Tank 85,000 Gallons
Boiler Walkway
Boiler Walkway
20 Ton Crane
House Unit
Evaporator
Evaporator Condenser
Vacuum Tank
Condenser
Closed Drip Tanks
Circulating Water Pump
Boiler Feed Pump Control
Pipe Chamber
Cold Surge Tank
Control Room
Control Panels
House Generator Reactor
Conduit Space
Battery Charging M.G. Sets
Load Centers
Closed Drip Tank Pumps
Transformer
Cooling Water Return Tank
526.0
Stack
Stack
Center Line of Steam Drums
Center Line of Mud Drums
Induced Draft Fan Discharge
Hoist Trolley 5 Tons
386.0'
Forced Draft Fan
Forced Draft Fan
Center Lines of Fan
Motor Control Cubicle
Boiler Room Floor
Boiler No. 2
Boiler No. 1



EXPANSION PROGRAM adds 200,000-kw installation to Hunter's Point steam station on shore of San Francisco Bay, at cost of about $30,000,000. Two new turbine generator units of 100,000 kw each are housed in steel-frame reinforced concrete building seen behind transformer banks in view at right. New structure is continuation of old turbine building at left, which contains 46,000-kw turbine generator served by two boiler units behind. Circulating sea water—200 cfs per unit—flows by gravity from bay through concrete tunnels. Fuel oil is delivered by barge and stored in tanks located out of picture at left. Turbine room, in view below, right, is seen looking from new part of building, housing two units, toward old installation of one unit in far background.

All boilers are of the semi-outdoor radiant type, the only protection from the weather being a transite canopy over the upper portion and a transite enclosed firing aisle. They supply steam at approximately 1,400 psi and at 95 deg F total temperature at the superheater outlet, although there are some variations between the plants. Forced and induced draft fans are used in all cases.

All apparatus is arranged as nearly symmetrically as possible about the boiler firing aisle as an axis, in order to allow operation with a minimum of personnel. Many automatic operating devices are used in the interest of dependability and economy of personnel. For instance, load changes on the generators will automatically adjust the fires under the boilers, the air input to support combustion, and the operation of the boiler feed pumps, and will maintain the proper relation between many other pieces of apparatus.

Fuel burners are provided to burn either oil or natural gas. Moss Landing and Contra Costa can be converted conveniently to use coal for fuel should it become advantageous. Hunters Point plant can be so converted at considerable expense. The Kern Plant was designed for gas or oil only.

Kern Plant Requires Cooling Towers

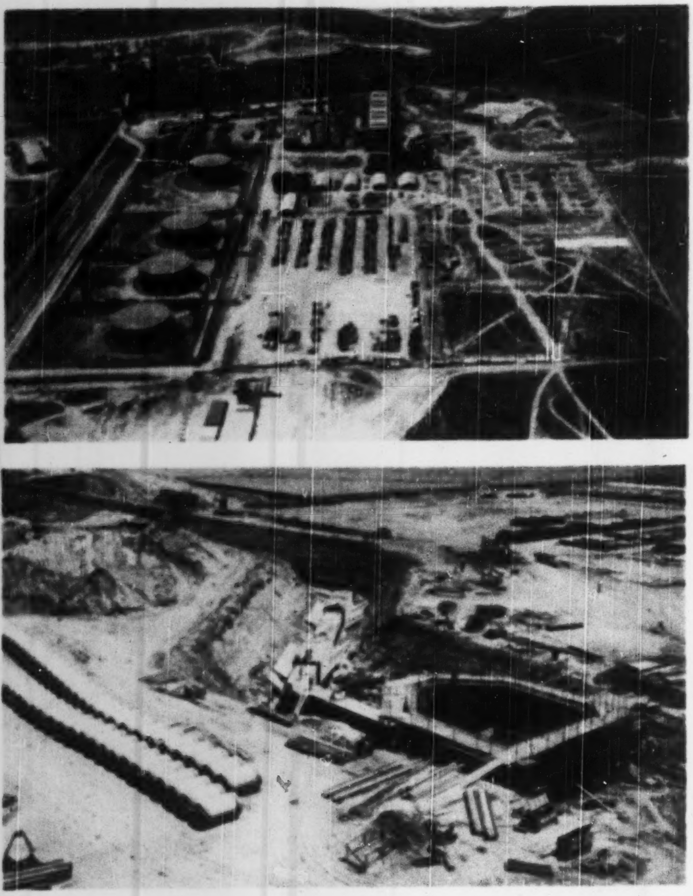
Kern plant is located on a 160-acre tract of level land about three miles west of Bakersfield, on the main line of the Santa Fe Railway. This plant is one of those not located near a body of water suitable for condenser cooling purposes and consequently two banks of cooling towers have been provided for the 75,000-kw Unit No. 1. Three more banks are being built for the 100,000-kw Unit No. 2, to be placed in operation early in 1950.

Soil conditions and strengths were found suitable for spread footings, which estimates indicated were less costly. The building is of simple functional design and is basically a heavy riveted steel frame supporting reinforced concrete walls, floors and roof. The exterior walls are provided with vertical and horizontal control joints to localize cracks.

Fuel oil is received by pipeline and stored in four welded steel tanks. Two tanks have a capacity of 40,000 bbl and two 80,000 bbl. Each tank is surrounded by an earth levee to retain the oil in case of tank failure. In addition to the fuel oil supply, natural gas is piped to the plant.

Hunters Point Station Put in Service

The original Hunters Point Station, or Station "P" as it is called, went into service in 1929. Two new units have been added, one late in 1948 and the other early in 1949. The building, on the shore of San Francisco Bay, about a mile north of the Navy Yard, is of steel frame and reinforced concrete construction, and houses one 46,000-kw turbine generator, two boilers, and the necessary auxiliaries. The site has the advantages of proximity to an important load center, un-



CONSTRUCTION PROGRESSES at site of Moss Landing Plant on Monterey Bay, California (top, left). Location of three-unit, 300,000-kw steam plant permits use of sea water in circulating system, designed to take from and return to harbor 390 mgd. Circulating-water discharge weir and outlet conduit are seen under construction in lower view.

limited circulating water and good foundation conditions. For these reasons it was chosen for a new 200,000-kw installation.

The foundation is of serpentine rock, well adapted for spread footings. Fuel oil is delivered by barge at a wharf anchorage and pumped into four oil tanks of 40,000 bbl capacity each. A tall circular reinforced concrete wall has been constructed around each tank to retain the oil in case of a break.

Circulating-Water Tunnels

Circulating sea water flows by gravity through concrete tunnels, part of which were constructed with the original plant, to pump pits near the condensers. The pumps, two for each unit, are the vertical, centrifugal type with a capacity of [illegible]0,000 gpm. At rated load each condenser will transfer 552,000,000 Btu per hour to the cooling water which is discharged into the bay. The circulating-water tunnels are so sectionalized that any part can be cleaned with only one main unit out of service. Six traveling screens at the tunnel intake remove debris from the water before it passes through pumps and condensers.

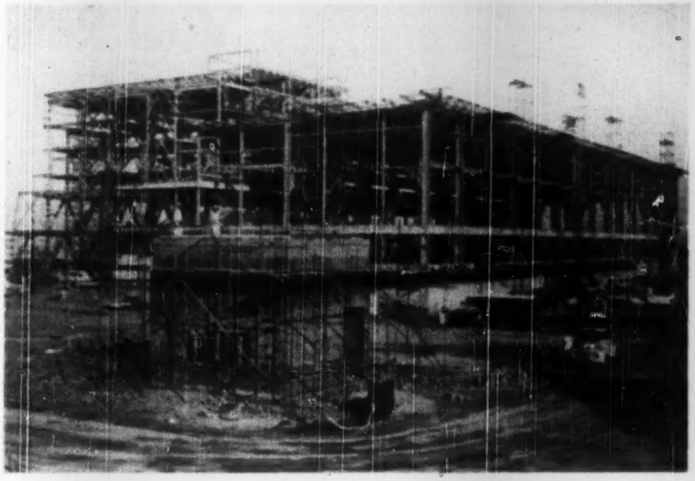
Moss Landing Plant Under Construction

The site of the Moss Landing Plant is a 271-acre tract on Monterey Bay just east of Moss Landing Harbor, and at the mouth of Elkhorn Slough, a tidal channel about six miles long. It is served by State Highway No. 1 and a spur track which was built from the main line of the Southern Pacific Railway nearby. The initial capacity of the plant will be 300,000 kw. Future expansion is anticipated. An important factor in the selection of this site was the proximity of Moss Landing Harbor from which circulating water is to be drawn. Water is discharged from the condensers into Elkhorn Slough at a point about 2,500 ft from the intake. At low tides, especially the ebb tide, it is possible that some of the warm discharge water will be drawn into the circulating system, with a consequent reduction in plant efficiency.

Analytical Study of Circulating-Water Problem Made

A thorough study of the circulating-water problem was made under the direction of members of the Mechanical Engineering Department of the University of California. At first it was thought that model tests would be necessary but upon further study it was decided that this method of approach would give no better results than the considerably less expensive analytical method. The problem is essentially one of open-channel tidal flow influenced by mixing and by density flow. Temperature-time histories were computed based on certain reasonable simplifying assumptions. The conclusion was reached that no significant recirculation would occur in the initial installation of 300,000 kw and that no reliable prediction could be made now for a greatly enlarged plant. A record of actual inlet and outlet temperatures for the initial installation will be kept for future use.

The circulating-water system will comprise an intake structure at the harbor's edge, a gravity-flow tunnel consisting of two rectangular cast-in-place barrels approximately 200 ft long between transitions, connecting to a screen and pump structure and six 54-in. centrifugally cast concrete pipes between the pumps and condenser. The six pumps have a capacity of about 100 cfs each. The total amount of water circulated through the three-unit plant will be about 600 cfs, which amounts to 390 mgd or about 4½ times the amount of water consumed during an average day for all purposes in the entire city of San Francisco. A discharge conduit extends from the condensers to an outlet structure at the bank of Elkhorn Slough. In order to minimize recir-



TURBINE-ROOM STEEL for Contra Costa Steam Plant is being erected while steel reinforced interlocking brick walls are constructed above concrete base. Boiler erection is under way in section at far left.

culation of cooling water, the opening in the intake structure is placed low down to take advantage of water stratification.

In view of the probability that mussels will grow on the walls of the inlet conduits, the tunnel from the intake structure to the screen and pump pit consists of two barrels to permit the cleaning of one barrel without shutting down the plant. Marine growth will be prevented also in the 54-in. pipes extending from the pumps to the condensers by temporarily reversing the flow and possibly by supplemental chemical treatment. A 48-in. pipe is provided for this purpose between the condensers and the screen pit. This plan is a modification of that used for the new Redondo Plant of the Southern California Edison Co. near Los Angeles.

Fuel oil will be delivered in large tankers of possibly 120,000-bbl capacity which will be moored offshore in 50 to 60 ft of water. Oil will be pumped through a flexible hose connecting to a steel pipe laid on the ocean bottom from the point of anchorage to the shore and thence to the storage tanks. Natural gas also will be piped to the plant. Should it become advantageous to burn coal, delivery can be made by boat or by rail. Fuel oil is stored in four 120,000-bbl welded tanks surrounded by earth levees.

Make-up water will be obtained from wells.

Pile Foundations Under Heavy Structures

After considerable study it was decided to use pile foundations under the main building, turbines, boilers, and stacks. Foundation material is composed of layers of dense, partially cemented sand interspersed with lenses of clay of varying thickness. The sand would be an ideal material for supporting spread footings were it not for the clay lenses which would compress under load and cause unequal and undesirable settlement in the building and machine foundations. The office bay and other minor sections of the building will be supported by spread footings.

Since all piles would be well above groundwater, the use of wood was precluded. Loading tests were conducted on precast concrete and on Raymond cast-in-place piles. An influential factor in the adoption of cast-in-place piles was that the exact length of precast piles could not be determined with reasonable accuracy because of the variable character of the soil. Considerable cutting off and building up of pile caps to desired elevations would be required. Cast-in-place piles are well adapted to such variation in length. All piles were placed under rigid inspection by jetting and driving. Designs contemplate loads of 35 tons per pile for dead and live loads and 50 tons including seismic loads.

The position of the first unit in the manufacturer's time schedule was such that it could be in operation about one year earlier than other machines on order, provided the design and construction schedules could be geared accordingly. A period of 21 months was allowed from the date of notification to Stone and Webster Engineering Corp. to proceed, an unusually fast schedule under present conditions.

At rated capacity, this plant will consume, per hour, about 570 bbl of oil or 3,700,000 cu ft of gas. Energy will be transmitted at 120,000 and 230,000 v. The first unit is scheduled for operation in the spring of 1950 and the other two about one year later.

Contra Costa Plant Under Construction

The fourth plant in the expansion program is Contra Costa, now under construction, which is located on a 167-acre site on the south bank of the San Joaquin River, about $2^1/_2$ miles east of Antioch, Calif. Initially 300,000 kw of capacity will be installed with provision for future expansion. Circulating water will be obtained from the San Joaquin River.

Numerous borings at the site indicate that an extensive and uniform bed of sand underlies the entire area at shallow but varying depths. Once again the question of spread footings versus pile footings arose. Estimated settlements indicated that pile foundations would be subject to less settlement than the spread footings and that in any case settlements would be reasonably uniform. Therefore it was decided to place the six boilers, stacks, and the auxiliary equipment such as boiler feed pumps and the "house" units on piles. Buildings and turbine foundations are on extensive wall and spread footings. The foundations for the three 100,000-kw units are integrated into one large spread footing, which also supports the adjacent intake and discharge tunnels and the condenser pump sumps.

Four Steam Plants Constructed by Outside Engineering Firms

Rather than to greatly expand its already large engineering and construction personnel, the Pacific Gas & Electric Co. has engaged outside engineering firms to design and construct these four steam plants. Stone & Webster Engineering Corp. is handling those at Kern, Hunters Point, and Moss Landing, while Bechtel Corp. is doing the work on Contra Costa. The firm of Dames & Moore was employed to make soil explorations and tests and to act as consultant on foundation designs for all four plants. These firms collaborate closely with our Engineering Department, which acts for the Company in coordination and general supervison of the work.

Engineers Play Vital Role in Building Construction

J. P. H. PERRY, M. ASCE

Vice-President, Turner Construction Co., New York, N.Y.

WHERE DO ENGINEERS fit into the design and construction picture on big buildings and how important are they on a large office or public building job? Ten engineers are required to work with each architect, the author says. In this article, based on an address at a recent joint meeting of the Pittsburgh Section of ASCE and the Engineers' Society of Western Pennsylvania, Mr. Perry draws on his four decades of experience with one large organization, which has constructed nearly one billion dollars worth of buildings during that time. As an elder statesman of the profession, Mr. Perry sees a good future in the building industry for alert, aggressive young civil engineers. He sees no letup in the demand of our growing population for buildings during the next generation.

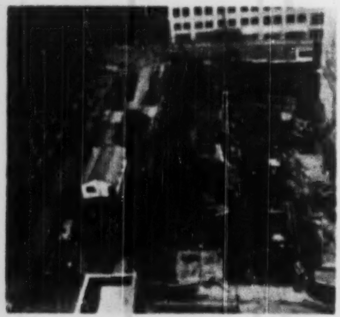
HOW MUCH of a factor is the engineer in American building construction? If a contractor's opinion, based on wide experience, is worth anything, the answer is, a very substantial factor indeed.

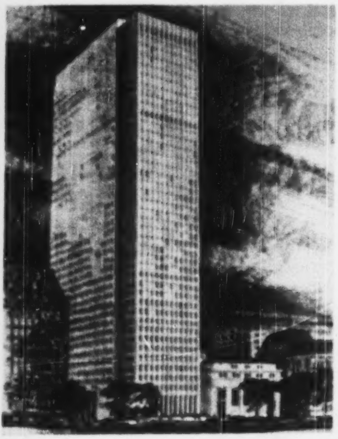
What happens when it is decided to put up a building?

The following steps are usually taken. The owner, be it corporation, institution, bank or individual, feels the need for a new building and secures a site. These two fundamental decisions, that is, to build and where to build, are made by the owner, generally without architectural or engineering advice, although in many cases the result might have been more satisfying if such advice had been sought early—at least before the site was acquired.

In general, the "use factors" determine the general characteristics of the building, its location, its design and what may properly be spent for its construction. These factors apply whether the structure be hotel, hospital, school, office building, factory or mausoleum. The "use factors" are all determined and established by the owner.

The indicated structure must now be designed and built with the funds available, to satisfy the demands of the "use factors" in the most effective manner. It is at this point that the technical adviser usually is called in.





DESIGN AND CONSTRUCTION of $25,000,000 Mellon Bank—U.S. Steel Building, Pittsburgh, Pa., required direct services of 166 engineers and 32 architects, or probable ratio of 10 engineers to each architect, including engineers employed by vendors of materials and subcontractors. Contractor, Turner Construction Co., started work on 41-story building (45 stories above foundation) in July 1949. Foundations 114 x 220 ft (above) are being carried about 80 ft below curb to solid rock. Drawing (right) shows appearance of completed building. Occupancy is scheduled for July 1951, which is two years from date of site acquisition.

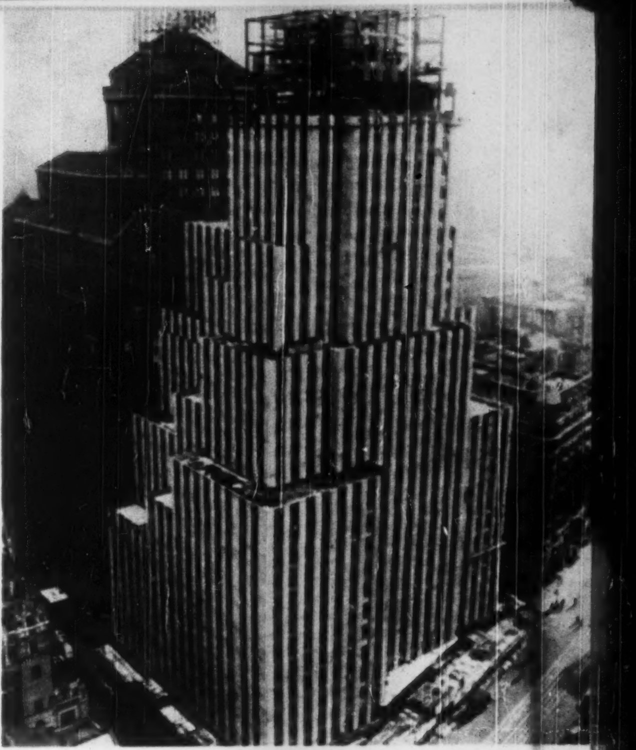
On institutional and commercial work the owner generally turns to an architect. Today the architect, struggling with the jigsaw puzzle of creating an economical, efficient and pleasing building to satisfy the "use factors," has to have the assistance of engineers to an ever increasing extent.

Recently there was a discussion in New Jersey between the American Institute of Architects and the New Jersey Society of Professional Engineers as to the broadening of the licensing law so as to give the engineer the right to file plans the same as the architect. During one of the discussions a prominent architect was asked whether he could design and construct a building without the help of engineers. He had to be frank and answered in the negative. It is an obvious fact that an engineer can design buildings that will stand up and be useful without an architect, although the resulting structure may not be as good looking or as well planned as the building designed by an architect.

In most important buildings one of the vital services rendered by the architect is to act as referee between his own staff, his engineers, and the owner. The architect is often in fact secretary of a building committee composed of owner, tenant (if it is a speculative building), architect and contractor, the architect recording the decisions of the committee in the shape of plans and specifications.

On the other hand, the engineer, important as he is collectively in the design and construction of modern American buildings, must never lose sight of the still properly dominant position of the great architects. The architect is the "Chief of Staff." He is to a big building job what SHEAF was behind the Normandy beachhead, or behind Patton's dash across five countries of Europe.

The architect sits at the head of the table and reconciles the many competing opinions and clashing points of view which in a healthy way arise out of consideration of ways and means, methods and materials, colors and qualities. Over and above his function of coordination and decision making is his unrivaled capacity to create and apply the esthetic elements that must enter into a satisfactory building.



CONSTRUCTION VIEW taken November 28, 1949, shows Mutual Life Insurance Co. Building just 5 months and 20 days after first piece of steel was erected. Eleven-million-dollar building at 55th Street and Broadway, New York, has height of 25 stories (30 above rock) and 575,000 sq ft of floor space. Record erection schedule was maintained. Structural steel and concrete floor arches were placed at average rate of 2.2 stories per week; limestone exterior walls at rate of 1.7 stories per week; aluminum spandrel facia, 1.9 floors per week; and glazing, 2.6 floors per week. Occupancy is scheduled for May 1950.

Furthermore, the architectural profession still retains leadership over the engineer in its talent for developing a sound plan and layout for an economical and efficient building. The engineer seems in general still to lack the broad and imaginative point of view needed to produce a good *parti*.

As an engineer, I always marvel at the type of genius an architect seems to possess, as evidenced by his ability to sketch on a blank piece of paper the outward and visible sign of the inward and spiritual grace of the building he proposes to design. To be sure, a good architectural library, with its record of what has been done in building design down the ages, is a great help.

The architect is sometimes rent by two philosophies. One of the great architectural firms of America, now in its fourth generation, is in general guided by the advice and admonition of one of its founding partners, "Never experiment with your client's money." On the other hand, one of the greatest architectural firms today is guided by the thinking of its senior member, which may be summed up in the words, "We have done that already. Let's try something new."

To reconcile these two opposing philosophies there is an increasing recognition of the need in the building industry for a completely independent testing laboratory to do for all new materials and construction methods what the Underwriters Laboratories in Chicago do for the fire resistant qualities of materials. To be sure, the Bureau of Standards in Washington is reliable but it does not go far enough. An architect or building engineer is faced with the claims of multitudinous vendors of building materials. He has no authoritative means of properly discounting or measuring these claims. He has no means of determining the effect of time and experience on the value of such materials. A well-financed laboratory that could function for architects, engineers, building contractors, subcontractors and the manufacturers of new materials would be of inestimable value. The Building Officials Conference of America is sponsoring and endeavoring to enlist financial support for the creation of such a building materials testing laboratory.

Two or three years ago I was one of the speakers in a symposium on the design of industrial buildings. Three Russian engineers also spoke. Their papers, giving a wide coverage of the various elements in the design and construction of industrial buildings in Russia, mentioned only the engineer. At the end of the meeting an American architect in the audience inquired as to whether architects were not used in the design of buildings in Russia. A conference between the three speakers brought the following answer through an interpreter: "Oh, in Russia the terms architect and engineer are synonymous."

Ten Engineers to One Architect

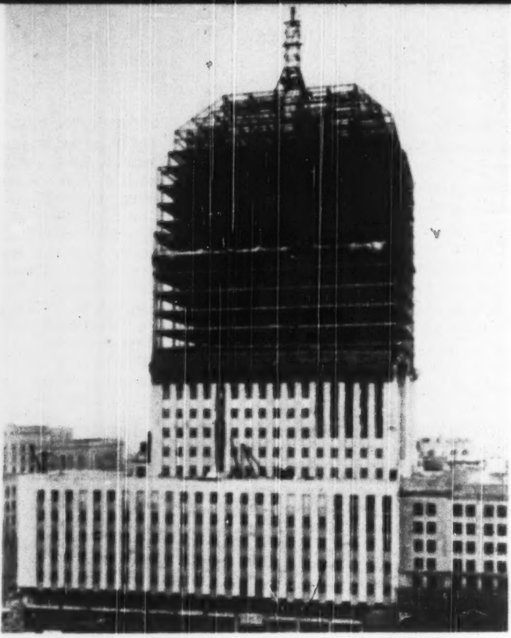
Let's see how the design and construction of a typical high-class office building is accomplished. Take for example the Mellon Bank-U.S. Steel Building now under way in Pittsburgh, a 41-story building—actually 45 stories above foundations—costing in excess of $25,000,000. It has approximately 1,000,000 sq ft of floor space, contains about 14,000,000 cu ft and requires about 14,500 tons of structural steel. It has a limestone and stainless steel exterior, a battery of 25 high-speed elevators, and full air-conditioning. From site possession to occupancy this monumental structure will take about 2 years to build. The plans are being prepared by Harrison & Abramovitz of New York and W. Y. Cocken of Pittsburgh as associate architects. The company I have spent my life with is the general contractor.

Has the engineer hid his light under the proverbial bushel? Could it be that in America we are getting to be like the Russians so far as our consideration of and differentiation between architects and engineers is concerned?

As for design, the architects have 32 of their staff assigned to the job and have engaged as structural engineers the firm of Edwards & Hjorth, who have assigned 11 engineers to the job and for foundations have retained the firm of Moran, Proctor, Freeman & Mueser, who have assigned 3 engineers to this problem. The mechanical engineers are Meyer, Strong & Jones, who are using 9 engineers on the project. The American Bridge Co. is using 60 engineers to detail the structural steel. The Westinghouse Co. has the elevator contract and will use about 60 engineers in designing and detailing this facility. The Turner Construction Co. has assigned 5 engineers in its office to the checking of shop drawings, preparation of purchasing schedules and making of cost studies. Thus a total of 148 engineers are assisting 32 architects in the design of this structure.

The predominance of engineering talent on this great project could be magnified considerably if it were possible to list the engineers working for all the subcontractors who will install plumbing, heating, lighting and sprinkler installations, to say nothing of vendors of air-conditioning units, steel sash, stainless steel spandrels and limestone facade.

When it comes to the construction



THIRTY-STORY STRUCTURE, with 1,100,000 cu ft of floor space, costing over $20,000,000, is John Hancock Mutual Life Insurance Co. Building, dedicated in Boston, September 1949, with Gram & Ferguson as architects and engineers. Their staff was split about equally between architects and engineers, while Turner Construction Co., general contractor, employed staff of 15 supervisory engineers and 4 office engineers. View at right was taken just ten months after foundation view, above.

of a building, the position of the engineer is more generally recognized. When the Mellon Bank–U.S. Steel Building job is running at its peak the general contractor's organization will consist of a vice-president as executive in charge at the main office, a resident project manager, one superintendent, 3 assistant superintendents, 2 or 3 line and grade parties, timekeepers, material checkers and expeditors, together with an accounting staff. All this supervisory staff, except for the job accountant and his crew, have been trained as engineers. These engineers number 18.

A résumé of the foregoing shows 166 engineers and 32 architects engaged in the design and construction of this important building—exclusive of engineers employed by vendors of materials and the principal subcontractors. Probably a ratio of 10 engineers to each architect would represent the ultimate total of professional talent engaged on the job, as witness also the record on the next succeeding building to be described here.

Mutual Life Insurance Co. Building

The Mellon Bank–U.S. Steel Building is not exceptional in the engineering talent required for its construction. Similar studies of two other building jobs with which I am familiar show the same general situation. The Mutual Life Insurance Co. of New York let a contract in mid-summer 1948 to the Turner Construction Co. for the construction of a 25-story building—30 stories above rock—at 55th Street and Broadway, Manhattan, having 575,000 sq ft of floor space and costing more than $11,000,000. Shreve, Lamb & Harmon Associates of New York are the architects. The following firms were engaged: Edwards & Hjorth of New York City to prepare structural design; Jaros, Baum & Bolles and Clark, McMullen & Riley, both of New York, to handle the mechanical installations; Bethlehem Steel Co. to fabricate and erect the steel frame; and Otis Elevator Co. to furnish the elevators. In the architect's office 15 architects were assigned to this project. Their consulting engineers, plus the steel company, the elevator company and the general contractor altogether had 114 engineers at work on the design. The general contractor's organization at the job site parallels that on the Mellon Bank–U.S. Steel Co. job and consists of 11 engineers. A recapitulation shows 15 architects assisted by 125 engineers.

Another example of how big office buildings are designed and constructed is the John Hancock Mutual Life Insurance Co. Building dedicated in Boston the end of last September. This is a building 30 stories high containing about 25,000 tons of structural steel, 1,100,000 sq ft of floor space and 16,000,000 cu ft, and costing in excess of $20,000,000. The architects and engineers were Cram & Ferguson of Boston. Structural steel was furnished by Bethlehem Steel Co., elevators and escalators by Otis and Westinghouse. Dr. Arthur Casagrande, M. ASCE, was the consultant on soil conditions. Cram & Ferguson's staff engaged in design and supervision was split about equally between architects and engineers. The number of engineers used by Bethlehem, Otis and Westinghouse parallels the number used on the two jobs already cited. The general contractor—Turner Construction Company—had a supervisory force of 15 engineers and 4 engineers in the office checking shop drawings, scheduling, making cost studies and rendering similar services.

To pursue this subject a little further, I had a survey made of the six largest and most prominent architects' offices in New York City with the following result. These six offices have staffs totaling 1,276 employees of which 189, or 15 percent, are engineers or men with engineering training.

Engineers Often Dominate Design

In the northeastern United States the engineer is more frequently responsible for the design of buildings than is generally realized. In the last four years my company has built 161 buildings at a total cost of $193,000,000. Of these, 81 were designed by engineers or engineering firms, the rest by architects.

Currently, the Turner Construction Company's permanent staff above the rank of foreman, and exclusive of stenographers and purely clerical help, includes 350 men, nearly all engineering graduates or men who have attended some 45 technical or engineering schools. In fact, 82 different universities and colleges are represented on the permanent staff. What is true of the

Turner Construction Co. is in general true of other leading building construction companies so far as the predominately technical composition of their staffs is concerned.

Institutional or public buildings—municipal, county, state or federal—follow much the same pattern. An architect dominates the design but relies increasingly on the advice and help of engineers. Smaller commercial buildings are handled similarly.

Industrial Buildings by Engineers

In one large class of buildings always under construction in this country the practice is a little different. I refer to industrial buildings, including factories, warehouses, chemical plants, steel works and power plants, in the design of which the engineer is increasingly prominent. While there are several great architectural-engineering firms with large practices along industrial lines, the larger part of industrial building design in this country today is in the hands of engineers rather than architects.

Industrial buildings are designed broadly by two different procedures: (1) The more general and long established, and perhaps more conservative setup, is for the owner to hire an architect or engineer or firm of engineers much as the architect is retained on commercial and institutional work. (2) In the so-called "package service" approach, the owner entrusts both the design and the construction to a firm of engineering contractors.

Under the first method, when the engineer is given the job, he takes the driver's seat away from the architect and relies upon the architect principally for advice on the esthetic elements of the building. Otherwise the professional functioning is pretty much the same as in the examples previously given.

Under the second method the engineering contractor combines under one management the functions ordinarily exercised by the architect and the contractor. There is much merit in this approach if an owner disregards competition, cross-checking of accounts, and puts his interest in results more than in cost. During World War II most of the enormous industrial expansion in America was done under what was essentially the "package service" procedure. Here the engineer and the contractor were given full sway. The so-called "A-E-M" Army form of contract—architects, engineers and management as one team—in many cases was actually operated with the engineer in the dominant position.

In any building operation, the design and construction of the mechanical services, including plumbing, heating, lighting, elevators, sprinklers, and air conditioning are vitally important. In big, high-grade office buildings this work will run as much as 40 percent of the total cost of the building.

On the John Hancock Mutual Life Insurance Co. Building in Boston this mechanical work amounted to 34½ percent of the cost of the structure above very unusual and costly foundations. On the Mutual Life Insurance Co. Office building in New York this percentage was 33 percent. On the Mellon Bank–U.S. Steel Building it is estimated that mechanical services will run about 39 percent of the cost above deep and costly foundations. On the United Nations Secretariat Building in New York City, being constructed by a specially organized group of contractors known as Fuller-Turner-Walsh-Slattery, Inc., out of the total cost of about $21,000,000 for the structure above foundations and adjacent driveways, these mechanical subcontracts total about $8,000,000, or 38 percent.

Good Future for Engineers

The opportunities for engineers in a large building contracting organization are good. In normal times, my company in the early spring sends its Personnel Director to 10 or 12 of the principal engineering schools in the East. With the help of the college authorities, he interviews the most promising civil engineering seniors and eventually after proper screening is able to offer employment to 10 to 15 promising men. These chaps start either as timekeepers, material clerks or line and grade men at a minimum starting salary, currently $225 a month. After an apprenticeship averaging about one year, those who show promise may become junior assistant superintendents or be brought into the main office in the Cost Department for training. At the end of 2 or 3 years more they should be senior assistant superintendents; after 7 or 8 years they should be junior superintendents; after 10 years, full-fledged superintendents. With good luck, in perhaps 20 years they ought to be either general superintendents or project managers on very large operations. After 25 or 30 years they may become a vice-president.

The qualities which lead to promotion along this ladder are rarely technical knowledge or attainment alone. In my 43 years with this company I cannot recall having seen a man promoted solely because of technical knowledge. Promotions have come to those whose personal characteristics, other than technical knowledge, are outstanding. For a man to succeed with our company he must possess aggressiveness, leadership, tact, ability to get things done, some charm of personality, and he must be one who rarely takes "no" for an answer.

The future for engineers in the building industry seems assured, at least for the next generation or two. If the forecast of the growth of the United States in the next 30 years, by Prof. Schlicter of Harvard in the November *Atlantic Monthly*, is anywhere near right the number of buildings that must be built to take care of that growth is legion. The number of schools, colleges, hospitals, recreation and amusement facilities needed, to say nothing of housing and transportation terminals, defies computation. The factory and warehouse floor space required to produce goods to satisfy the ever increasing consumption and demand of our population is staggering in its immensity. As buildings get more and more complicated technically, and old types of brick and masonry exterior walls and plastered partitions are replaced by metal skin facings and movable partitions, with increasingly effective lighting, acoustical treatment and air-conditioning, the position of the engineer as a co-worker and right-hand man of the architect will continue to be secure.

Good Outlook for Building Construction

As for the construction industry in general, particularly in the eastern part of the country, the position in which my company finds itself is probably a good indication of what the general situation is among building contractors. In 1949 we expect to do something over $54,000,000 of business. We will go into the year 1950 with a 60 percent larger backlog of signed contracts on our books than we had at this time a year ago. We look forward to 1950 as a good year; in fact it may be a record peacetime year for the company and perhaps an all-time high, excepting only the war year 1942.

Anyone trying to look into the future of the building industry should not forget two things: First, what John Gunther said in his book *Inside U.S.A.*, that "America is lousy with greatness," and second, how rapidly our population is growing. This increase since 1940 has outrun most forecasts and, in America, babies ultimately mean buildings.

Bids Confirm 15 Percent Estimated Saving In Jacketless Tunnel Tube

Baytown Tunnel, Texas, Designed Without Tremie Jacket, Saves Builders $948,157

S. A. THORESEN, M. ASCE

Consultant, Parsons, Brinckerhoff, Hall & Macdonald,
New York, N.Y.

THE BAYTOWN TUNNEL is the latest development in the economical design of the trench and precast type of under-water tunnel. By building the tunnel without the usual outside jacket of tremie concrete, the engineers were able to save almost a million dollars, making the bid 16 percent lower than that on the conventional design. The design was developed by the author as a result of his 45 years of experience and research in the field of tunnel construction.

ECONOMIES IN the trench and precast type of tunnel construction have been realized by designing the tunnel tubes without tremie concrete jackets. In this type of tunnel, the tubes are prefabricated on shipways, launched, floated into position, sunk into a dredged trench and backfilled. In the case of the Baytown, Tex., single-tube vehicular tunnel here described, the bids confirmed the estimated savings. The lowest bid was $4,860,205 for the jacketless design, as compared with $5,808,362, the only bid received for the alternative design, a tube with a tremie concrete jacket outside the tube, as well as a lining.

The Baytown Tunnel (Fig. 1) is being constructed at present under the Houston Ship Channel, between La Porte and Baytown, by the Texas State Highway Department as part of the relocation of State Highway 146. The profile and section of this tunnel are shown in Figs. 2 and 3. Since the tunnel is now in the early stages of construction, this description will be confined to the design features.

It may appear that there is no novelty in building a tunnel in sections above ground, floating and towing each section to a previously dredged trench, sinking it, and joining the sections under water. While the Baytown Tunnel has been designed for construction according to the well established trench and precast procedure, there are some deviations which are noteworthy.

Favorable conditions for the selection of this type of tunnel include river-bottom soil of such consistency that the trench sides will assume slopes not flatter than 3 or $3\frac{1}{2}$ horizontal to 1 vertical, an ample spoil area at minimum rental, available close to the tunnel trench for disposal or storage of excavated material, and low cost of land. These criteria are fulfilled at the Baytown Tunnel site. For a considerable distance on both sides of the ship channel the land is low lying and unimproved, resulting in low acquisition costs and providing a convenient spoil area for dredged material, because of the need for considerable approach embankments. Borings taken in the channel revealed that material to be dredged is capable of sustaining relatively steep slopes, thus insuring low trenching costs.

The tunnel proper will be 3,009 ft long between portals, which, together with a 551-ft open U-shaped approach at each end, gives a combined length of tunnel and approaches of 4,111 ft. The tunnel proper is designed for construction under two methods—2,557 ft by the trench and precast tunnel method; and 226 ft at each portal in the dry by the cut-and-cover method. The single ventilation building, near the north portal, has its substructure incorporated in the cut-and-cover section.

The project is divided into three contracts. Contract No. 1, the subject of this article, comprises the 2,557-ft subaqueous portion of the tunnel which is designed with an outside steel shell to be fabricated on shipways in six 300-ft, and three 250-ft steel shells, joined as shown in Fig. 4, each 34 ft 10 in. in diameter and having a shell plate thickness of $\frac{1}{2}$ in., for construction according to trench and precast methods. Contract No. 2 includes the cut-and-cover concrete tube, open approach structures, ventilation building, service buildings and ventilation and mechanical systems. Contract No. 3 consists of the finishing work, including paving, tunnel lighting, tiling and miscellaneous work.

Bids were taken on two types of tunnel (Fig. 5), the circular section designated as Type S, and the octagonal section designated as Type T. Steel shells were used in both cases. Type T is the same as that used for the Detroit-Canada, Bankhead, and State Street tunnels and for the Pasadena Crossing under the Houston Ship Channel which is now being built. Type S is a single steel tube with the structural concrete located entirely on the inside of the tube, resembling in this respect the La Salle Street tunnel. However, it should be noted that the latter is a twin-tube tunnel, which lacks the inherent structural strength of a single tube.

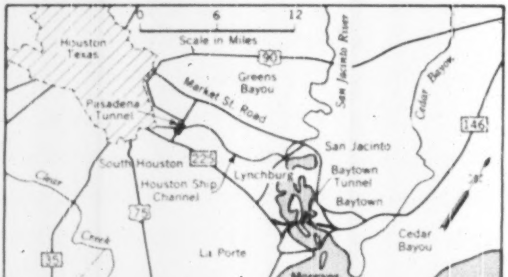


FIG. 1. BAYTOWN TUNNEL is part of improvement program on Texas State Highway 146. Total length of new tunnel under Houston Ship Channel is 4,111 ft. Nearby Pasadena Tunnel ("Civil Engineering" for March 1949), also of trench and precast type, is similarly designed except that it has tremie concrete jacket.

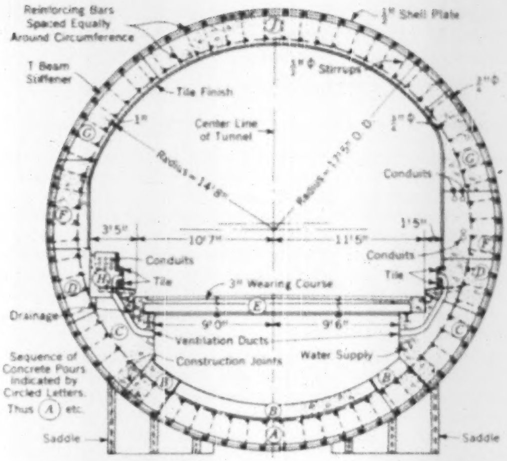

Reinforcing Bars Spaced Equally Around Circumference
$\frac{1}{2}$" Shell Plate
T Beam Stiffener
$\frac{1}{2}$" ϕ Stirrups
$\frac{3}{4}$" ϕ
Tile Finish
1"
Center Line of Tunnel
$\frac{3}{4}$" ϕ
Radius = 14'8"
Radius = 17'5" O.D.
Conduits
G
G
F
F
3'5"
10'7"
11'5"
1'5"
Conduits
Conduits
Tile
Tile
H
D
D
3" Wearing Course
E
Drainage
9'0"
9'6"
C
C
Ventilation Ducts
Construction Joints
Water Supply
Sequence of Concrete Pours Indicated by Circled Letters. Thus A etc.
B
B
B
A
Saddle
Saddle

FIG. 2. **TYPICAL SECTION of Baytown Tunnel shows location of air ducts, and water and electrical conduits. T-beam stiffener, half of I-beam section, is welded to steel tube.**

The low bidder submitted his price for the Type S only, showing a saving of 16 percent compared with the sole bid submitted for the Type T. The contract was awarded on the basis of using the former. Type S consists of a circular steel shell, reinforced by internal stiffener rings and ring girders, with a reinforced concrete lining. The active section of the tube is assumed to consist of the stiffener rings, the concrete and the reinforcing bars.

Three separate design conditions were considered: (1) The steel shell supported on the shipways, ready for launching; (2) the steel shell floating in the water while the concrete lining is being placed; (3) the tube in its final location after sinking, with backfill in place.

While on the shipways, the ring-girders in the shell support the weight of the tubes. The ring-girders and secondary stiffener rings are formed by welding the T-sections to the shell, producing, with a part of the shell, I-beams of high resistance. Calculation of stresses is based on the theory developed by Herman Schorer (Design of Large Pipelines, ASCE TRANSACTIONS, Vol. 98) and enlarged by H. A. Foster (Formulas Facilitate Design of Ring-Girder-Supported Pipes, CIVIL ENGINEERING, September 1949).

The width of the first and subsequent concrete strips placed inside the shell was limited in order not to overstress the shell either by transverse or by longitudinal moments. A further consideration was the amount of concrete that can be poured without interruption, since it is preferable not to have transverse joints in any strip. The third condition, with the tube in its final location, demands that, if the wall is of uniform thickness and of just sufficient weight to cause full submergence, there will be no bending moments in the tube.

The loading of the tunnel under backfill passes through three stages: First, in fresh backfill, having a low angle of repose and a coefficient, C_p, for lateral earth pressure of at least 0.50, this condition is not critical, since an increase in side pressure reduces the moment load on the tunnel section. During the second stage the backfill is consolidating, with a corresponding increase in the internal friction of the soil. This stage will produce the most critical loading, as the reduced lateral earth pressure results in a larger moment load in the cross section because the weight of the fill rests directly on the tunnel. A minimum value of 0.27 for the coefficient C_p has been assumed for this stage.

The last stage is reached when the backfill has completed its consolidation, so that the material can be considered as an elastic mass. External loads on the tunnel can then be analyzed according to the formulas of Froehlich, if at some future time it should be desired to reclaim the area over the tunnel by filling to a higher level. In spite of the greater overburden, tunnel stresses for this condition would be below the design stresses.

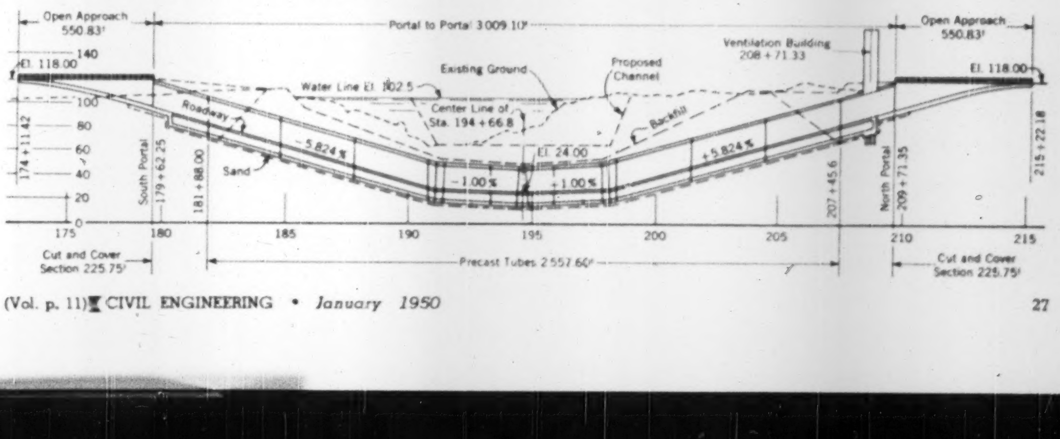
The difference between Types T and S is minor, except for the octagonal concrete jacket and thinner steel shell and concrete lining of Type T, which has a total thickness of jacket and lining equal to that of the lining alone of Type S. An economical analysis of the two types discloses advantages in favor of Type S as follows:

1. Simplification of shell fabrication lowers the cost of the electric arc welding required for assembly and final connections.

2. Lower concreting costs are secured by eliminating the tremie concrete jacket and by avoiding the additional form work required for Type T. Delays due to bad weather and other unfavorable working conditions are also avoided by placing the concrete lining inside the dry protective covering of the prefabricated steel shell.

3. The interior concrete lining is designed to be placed eccentric to the horizontal axis, resulting in a shell thickness of 3 ft 9 in. at the invert and diminishing to 2 ft 9 in. at the crown. This arrangement, which lowers the metacenter, assures greater stability of the floating tubes, with resulting cost savings in concreting and ballasting.

FIG. 3. **TWO METHODS are being used in construction of Baytown Tunnel, profile of which appears here. Center section 2,557 ft long, placed by trench and precast method, is flanked by 226-ft length of cut-and-cover construction at each portal. Center section contains six 300-ft steel shells and three 250-ft steel shells, each 34 ft 10 in. in diameter.**


Open Approach 550.83'
Portal to Portal 3,009.10'
Open Approach 550.83'
Ventilation Building 208 + 71.33
El. 118.00
El. 118.00
140
Existing Ground
Proposed Channel
Water Line El. 102.5
100
Roadway
Center Line of Sta. 194 + 66.8
Backfill
80
60
40
20
0
174 + 11.42
South Portal
179 + 62.25
181 + 88.00
Sand
- 5.824 %
El. 24.00
- 1.00 %
+ 1.00 %
+ 5.824 %
207 + 45.6
North Portal
209 + 71.35
215 + 22.18
175
180
185
190
195
200
205
210
215
Cut and Cover Section 225.75'
Precast Tubes 2,557.60'
Cut and Cover Section 225.75'

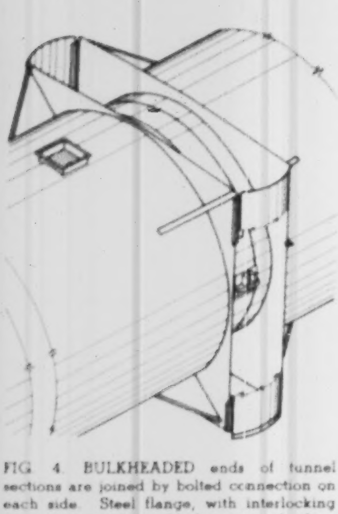


FIG. 4. **BULKHEADED** ends of tunnel sections are joined by bolted connection on each side. Steel flange, with interlocking sheetpile knuckles welded to vertical edges on each section, is welded into position before section is sunk. Sections are bolted together under water, and steel plates are then sprung into sheetpile joints. Entire joint is filled with tremie concrete. Minimum of underwater work contributes to low cost.

4. Economical use of structural steel, reinforcing steel and concrete lining, facilitated design calculations and methods of fabrication. All concrete in the tube forms a unit to resist the forces acting on the tube in place.

In addition to the features enumerated above, construction advantages are expected to develop during the fabrication and construction of the tubes which will furnish a valuable precedent for such work on future tunnels.

The Baytown Tunnel is being built jointly by the Texas State Highway Department and the U.S. Bureau of Public Roads under the direction of D. C. Greer, M. ASCE, State Highway Engineer. Contractor for the subaqueous portion of the tunnel is Brown & Root, Inc., Houston, Tex. I. S. Waterbury, J. O. Bickel, H. A. Foster, and J. J. White, all members of ASCE, and S. Steuerman, were in charge of the design and principal details of the tunnel for the firm of Parsons, Brinckerhoff, Hall and Macdonald.

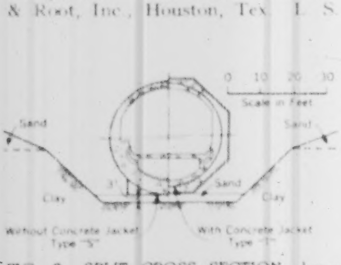

0 10 20 30
Scale in Feet
Sand
Sand
3'
Sand
Clay
Clay
Without Concrete Jacket Type "S"
With Concrete Jacket Type "T"

FIG. 5. SPLIT CROSS SECTION shows two proposed designs for Baytown Tunnel. Bids substantiated estimated 15 percent saving in jacketless design. Type S (left)

Progress in Construction of Trench and Precast Tunnels Reviewed

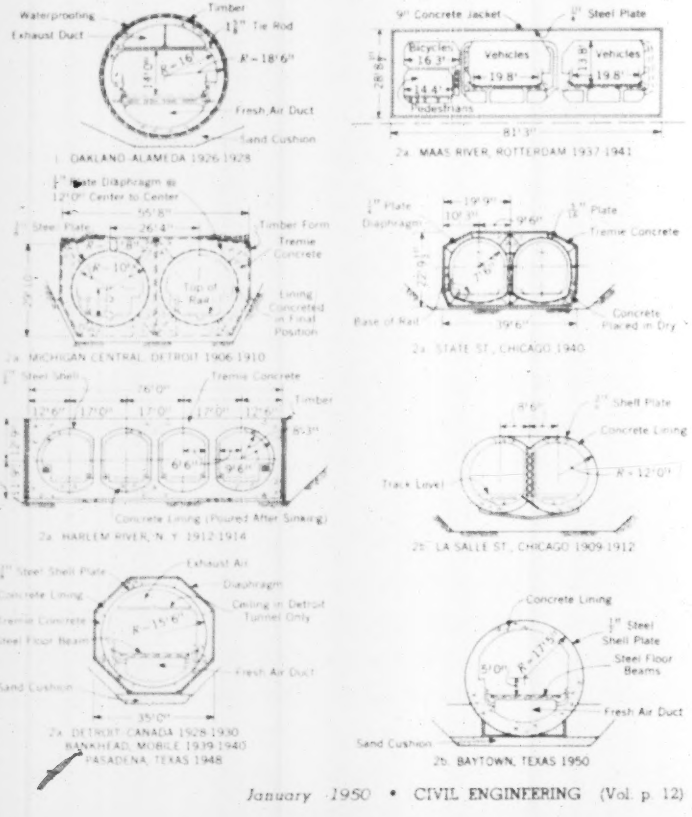
A brief résumé of the history of trench and precast tunnels will prove useful in understanding the foregoing description of the Baytown Tunnel. Figure 6 illustrates the three classes of such tunnels which have been built to date. The first major difference to be noted is whether or not steel shells are used. In the case of the Oakland-Alameda Tunnel, California, Class 1, no steel shell was used, whereas such shells were provided for all the other tunnels. The steel-shell tunnels are divided into two groups, Class 2 *(a)* and 2 *(b)*, with and without an outside concrete jacket, respectively.

For each of the tunnels shown, the trench requirements were generally the same and followed orthodox dredging methods. Essential features of construction are common to all the tunnels, except for the following modifications:

The one precast reinforced concrete tunnel without steel shells, Class 1—the Oakland-Alameda tunnel in California—was completed in 1928. It was precast in 203-ft sections and covered on the outside surface with membrane waterproofing protected by wood lagging. All construction work was done in a drydock—none was performed on the floating section.

Of the seven tunnels having a steel shell between the concrete lining and the concrete jacket, designated Class 2 *(a)*, no concrete work was performed on the floating shell sections of the two oldest—the Michigan Central Railroad tunnel under the Detroit

FIG. 6. **MOST RECENT** step in design of trench and precast type tunnel is Baytown Tunnel, Texas. Designed without tremie concrete jacket, this tunnel is almost one million dollars cheaper than similar structure with concrete jacket.


Waterproofing
Exhaust Duct
Timber
$1\frac{5}{8}$" Tie Rod
R = 18'6"
R = 16'
14'0"
Fresh Air Duct
Sand Cushion
$\frac{1}{4}$" Plate Diaphragm @ 12'0" Center to Center
55'8"
26'4"
$\frac{3}{8}$" Steel Plate
Timber Form
Tremie Concrete
R = 10'
Top of Rail
Lining Concreted in Final Position
$\frac{3}{8}$" Steel Shell
Tremie Concrete
76'0"
12'6" 17'0" 17'0" 17'0" 12'6"
Timber
8'3"
6'6"
9'6"
Concrete Lining (Poured After Sinking)
$\frac{3}{8}$" Steel Shell Plate
Exhaust Air
Diaphragm
Concrete Lining
Ceiling in Detroit Tunnel Only
Tremie Concrete
R = 15'6"
Steel Floor Beam
Fresh Air Duct
Sand Cushion
35'0"
9" Concrete Jacket
$\frac{1}{4}$" Steel Plate
Bicycles
16.3'
14.4'
Pedestrians
Vehicles
19.8'
Vehicles
13.8'
19.8'
28'8"
81'3"
$\frac{1}{4}$" Plate Diaphragm
19'9"
10'3"
9'6"
$\frac{5}{16}$" Plate
Tremie Concrete
7'6"
22'9"
Base of Rail
39'6"
Concrete Placed in Dry
8'6"
$\frac{3}{8}$" Shell Plate
Concrete Lining
R = 12'0"
Track Level
Concrete Lining
$\frac{1}{2}$" Steel Shell Plate
5'0"
R = 17'5"
Steel Floor Beams
Fresh Air Duct
Sand Cushion

1. OAKLAND-ALAMEDA 1926-1928

2a. MICHIGAN CENTRAL, DETROIT 1906-1910

2a. HARLEM RIVER, N. Y. 1912-1914

2a. DETROIT-CANADA 1928-1930
BANKHEAD, MOBILE 1939-1940
PASADENA, TEXAS 1948

2a. MAAS RIVER, ROTTERDAM 1937-1941

2a. STATE ST., CHICAGO 1940

2b. LA SALLE ST., CHICAGO 1909-1912

2b. BAYTOWN, TEXAS 1950

River, completed in 1910, and the New York City Subway System Tunnel under the Harlem River, completed in 1916. All concreting on these tunnels was done after the steel shells were sunk in place.

Steel tubes for the Michigan Central tunnel were constructed in 262-ft sections. After sinking, the concrete jacket was poured by the tremie method, the trench backfilled, and the tubes dewatered. The lining concrete was poured through an access pipe in each tube.

Construction of the Harlem River tunnel closely resembled that described for the Michigan Central, except that the steel sections were constructed in 220-ft lengths of four tubes each. The two outer tubes of each section were fully bulkheaded at the ends and the two inner tubes were bulkheaded for only 4 ft of their diameter, as required for flotation. In these two tunnels, the lining was built after the jackets and the shells took the full load. The lining, therefore, was not a part of the supporting structure.

The five other Class 2 (*a*) tunnels shown in Fig. 6 are all single-tube vehicular tunnels except the State Street Tunnel under the Chicago River, which is a twin-tube subway traction tunnel, and the Rotterdam tunnel, which provides for three tubes, two for vehicular traffic and the third in two stories, the upper one for bicycles and the lower one for pedestrians. In each case, the steel shell was towed to an outfitting dock where the reinforced concrete lining was placed while the tube was afloat. The concrete jacket was also poured at the outfitting dock except in the case of the Bankhead and Rotterdam tunnels. For the Bankhead Tunnel the lower half of the jacket was poured in a drydock. After the tube was towed to the tunnel site, sufficient additional jacket concrete was poured to overcome buoyancy and the remainder was poured by tremie after sinking and joining the tubes. In the case of the Rotterdam tunnel, construction of the sections was accomplished in two stages—first, in a drydock, and second, in a construction dock. In the strength analysis of these five tunnels, the tremie concrete of the jacket was neglected; the steel structure and the lining took all loads acting on the tube.

Except for the Baytown Tunnel, at present under construction, only one tunnel with the steel shell outside of the concrete has been constructed to date—the LaSalle Street tunnel under the Chicago River, completed in 1912. The steel shell of this 278-ft-long twin-tube railway tunnel was constructed in one piece in a drydock, bulkheaded at the ends, launched, and towed to a wharf where the lining concrete was placed. The steel shell was designed to serve as both a waterproofing course and the outside form for the concrete lining; it was not regarded as contributing to the strength of the structure. End compartments in each tube were control flooded for sinking. Cofferdams were provided at the ends for connecting the tunnel to its open approaches.

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Sphere Developed from Icosahedron Cuts Steel Fabrication Costs

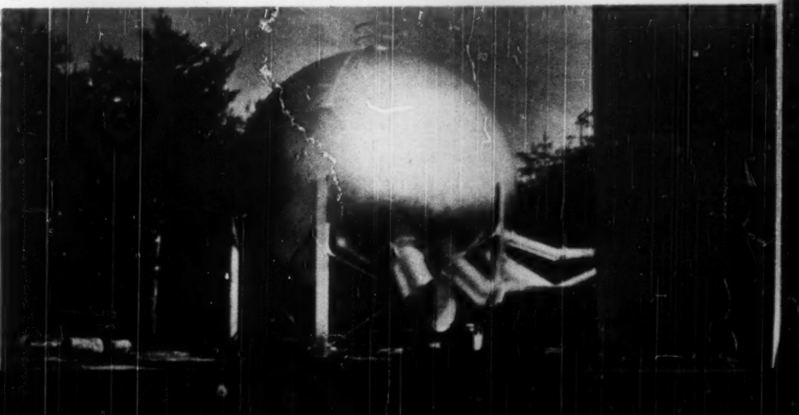
A NEW METHOD of fabricating spherical steel shells based on the icosahedron minimizes the amount of ordered waste per plate and the length of welded seams. The method was developed by J. O. Jackson, M. ASCE, Vice-President, Pittsburgh–Des Moines Steel Co.

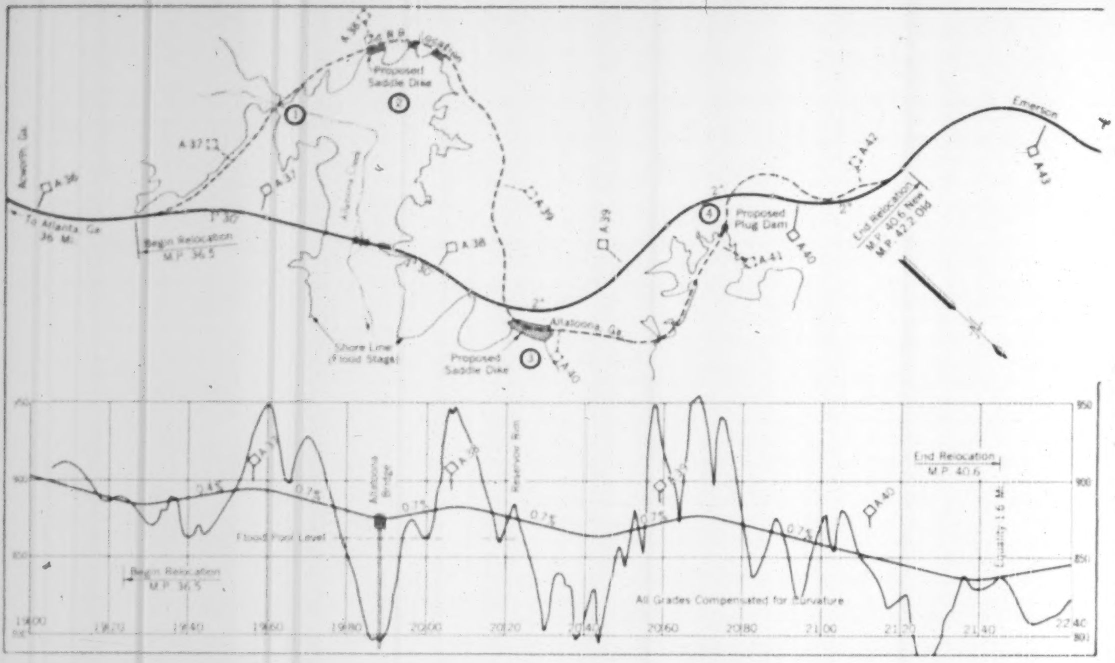
The new construction, called the icosasphere, is based on the fact that four adjacent sides of a 20-sided polyhedron can be flattened to form a parallelogram. This parallelogram is the basic shape of the steel plates in the sphere. (Photos show 32-ft sphere.)

Experimentation with pieces of plastic material which had been heated and molded into spherical segments led to the development of the method. The pieces of plastic were all trimmed to the same shape, reheated and flattened, thus giving the precise shape of the flat pieces of steel which, when dished, would form the complete sphere.

Two other systems are currently used to fabricate spheres: (1) the orange-peel layout—a sphere with two dished plates at top and bottom, and side plates resembling orange segments; and (2) the cube layout, based on the six-sided polyhedron. For a 10-ft-dia sphere, the icosasphere gives only 18 percent ordered waste, whereas the orange-peel layout wastes 40 percent and the cube, 20 percent. For a 50-ft-dia sphere, the waste with the icosasphere layout drops to 11 percent equaled only by a variation of the orange-peel construction, which, however, requires 2,323 ft of welded seam as compared with 1,418 ft for the icosasphere.

A complete report on the icosahedron technique (covered by patent applications owned by Pittsburgh–Des Moines Steel Co.) has been published by the Company's Research Department.




Acworth, Ga.
To Atlanta, Ga. 36 Mi.
Begin Relocation M.P. 36.5
A 36
A 37
A 37
A 38
A 39
A 39
A 40
A 41
A 42
A 43
N.C. & St. L. Relocation
Proposed Saddle Dike
Allatoona Creek
Shore Line (Flood Stage)
Proposed Saddle Dike
Allatoona, Ga.
Proposed Plug Dam
End Relocation M.P. 40.6 New M.P. 42.2 Old
Emerson
1
2
3
4
Allatoona Bridge
Reservoir Rim
Flood Pool Level
End Relocation M.P. 40.6
Equality 1.6 Mi.
Begin Relocation M.P. 36.5
All Grades Compensated for Curvature
0.75%
1900
1920
1940
1960
1980
2000
2020
2040
2060
2080
2100
2120
2140
2240
950
900
850
800

Georgia Western and Atlantic Railroad Relocated Through Allatoona Reservoir

J. HOUSTOUN JOHNSTON, M. ASCE
Consulting Engineer, Georgia Public Service Commission

and J. C. AKER
Chief Engineer, The Nashville, Chattanooga & St. Louis Railway

FOR THE PAST five years the Nashville, Chattanooga & St. Louis Railway has been carrying out a curve reduction and modernization program between Atlanta, Ga., and Memphis, Tenn., to provide faster service for both passenger and freight trains. Ninety-two separate projects, involving over 80 miles of new track, have been completed at a cost of several million dollars. Latest of these projects, the Allatoona relocation, was brought to a head by the proposed construction of Allatoona Dam by the Corps of Engineers of the War Department.

The section of track requiring relocation because of reservoir construction is a part of the old Western & Atlantic Railroad of the State of Georgia, created by an Act of the General Assembly of Georgia, approved by the Governor December 21, 1836. The Governor appointed as chief engineer Lt. Col. Stephen H. Long, on leave of absence from the U.S. Army, who made the reconnaissances, preliminary surveys and final location for the line from Atlanta, Ga., to Chattanooga, Tenn.

At that time there were only three or four railroads in the United States, and of the science of railroad engineering little was known. The terrain to be traversed was broken by many high ridges and streams, and as finally constructed the railroad stood out as a remarkable achievement. Colonel Long, in his report to the Governor dated November 7, 1837, says:

"The conditions prescribed as governing principles for the location and construction of the road were such as were suggested by a careful reconnaissance of the country and the obvious importance of the enterprise and were briefly as follows, viz., that the gradations along the line of road should not exceed 30 ft per mile ($^{6}/_{10}$ = %); that its curvature should be limited to a radius of 1,000 ft (practically 6-deg curve). . . ."

Many difficulties, such as financing, labor, shortage of technical men and

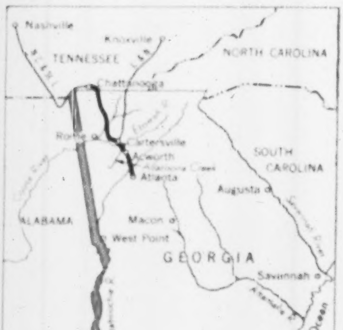

Nashville
Knoxville
TENNESSEE
NORTH CAROLINA
Chattanooga
Rome
Cartersville
Acworth
Allatoona Creek
Atlanta
SOUTH CAROLINA
Augusta
ALABAMA
Macon
West Point
GEORGIA
Savannah
Atlantic Ocean
FLORIDA
Jacksonville

FIG. 2. STATE-OWNED 13-mile Western & Atlantic Railroad, completed in 1850 between Atlanta and Chattanooga, is now operated by Nashville, Chattanooga & St. Louis Railway. W. & A. is said to be one of most heavily traveled single-track lines in United States.

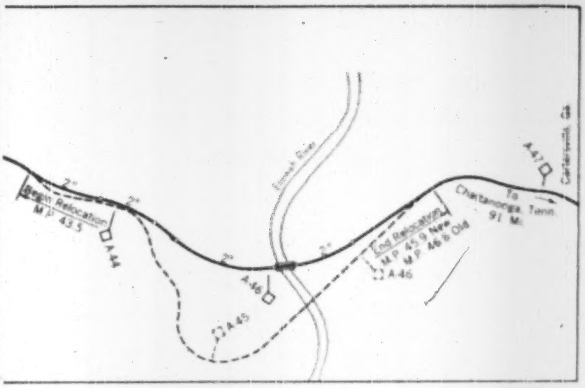


FIG. 1. ALLATOONA alignment revision (far left), completed in 1949, raised tracks above government flood pool behind Allatoona Dam near Cartersville, Ga., as part of N. C. & St. L. Railway curve-reduction program. Line change at Etowah River crossing (left) was completed in 1944.

material delayed construction, but on completion of the tunnel near the Georgia State border on May 9, 1850, the line was opened for traffic from Atlanta to Chattanooga, a distance of 137 miles. Until recently the original line remained unchanged (Figs. 1 and 2).

The road was operated by the State until December 27, 1890, when it was leased to The Nashville, Chattanooga & St. Louis Railway. Under a trackage agreement, trains of the Louisville & Nashville, Atlanta-Knoxville Division, also operate over the Western & Atlantic between Atlanta and Cartersville, Ga., in which is included the segment involved in the Allatoona pool. Therefore the Western & Atlantic Railroad is an important link between the Atlantic Coast Line Railroad on the east and the Louisville & Nashville Railroad on the west. The combined traffic of the two lines makes it one of the most heavily traveled single-track routes in the United States.

Construction of Allatoona Dam for flood control will affect the old location of the Western & Atlantic at four points (shown in Fig. 1 by heavily circled numerals): (1) The crossing of Allatoona Creek, where bridge and approach embankments would be flooded; (2) Old Mile Post 38, where three extensive saddle dikes will be necessary; (3) Old Mile Post 40, where a large saddle dike will be required to maintain the reservoir at flood stage; and (4) Old Mile Post 41, where the old railroad crosses the reservoir rim at an elevation lower than the proposed flood pool elevation.

The Corps of Engineers originally proposed protection of the railroad at point (1), by an alignment change, building a new bridge and raising the approach fills above flood level; at points (2) and (3), by building protective dikes along the reservoir side of the railway; and at point (4), by a series of dikes and a stoplog structure. The stoplog structure was to be a removable dam constructed in the railroad cut on the reservoir rim, to be set up only during flood periods, but needless to say, when it was in place trains could not operate.

The Corps of Engineers later amended these plans, proposing the protection of points (1) and (2) as already described, but proposing to move the railroad entirely out of the reservoir from about Old Mile Post 39 to Old Mile Post 41.6. This plan was more economical than the original, in that the old railroad embankment at point (3) (Old Mile Post 40), which was at the top of a narrow ridge, could be used as the core of the large saddle dike, thereby greatly reducing grading quantities on the dike, and at point (4) only a plug dam, which amounted to no more than filling the narrow railroad cut, was necessary.

Both of these proposals were unacceptable to the railway management and to the State of Georgia because once the reservoir is full, no alignment corrections can be made economically. The road would then be forever the possessor of the winding track between Old Mile Posts 37 and 39, always a restricted speed zone.

After several years of negotiations, an agreement was reached whereby the War Department purchased the existing railroad right-of-way outright within the limits affected by the reservoir, allowing the railway time to relocate its track between these limits, and to salvage such fixtures as it desired. The new railroad necessarily would have to be designed to withstand reservoir conditions without any interference with the operation of the reservoir.

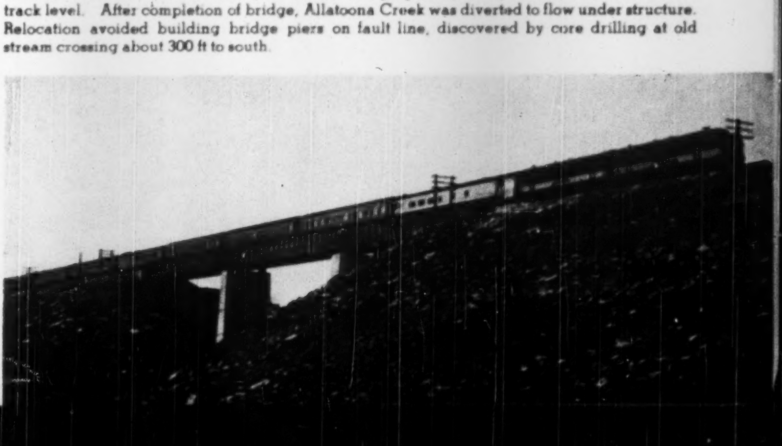
Because of very broken terrain, the task of locating a new line in this territory was difficult. The alignment finally selected gives the least possible exposure to the reservoir and is the most economical from a grading standpoint. At the same time it meets the N.C. & St. L. Railway's standards for construction of main-line track as regards grades and curvature, as recommended by the American Railway Engineering Association.

New Alignment Removes Speed Restrictions

The maximum curve on the new line is 2 deg, on the old 6 deg; there are only five curves on the new, compared with 27 on the old; the total central angle on the new is 240 deg, on the old 968 deg. Twenty-two curves thus are eliminated and enough central angle to make two complete circles. The length of the new line

CUT 85 FT DEEP for railroad relocation through very hard rock broke irregularly at MP 39.2.

CONSTRUCTED ON DRY LAND, Allatoona Bridge piers (below) rest on rock 90 ft below track level. After completion of bridge, Allatoona Creek was diverted to flow under structure. Relocation avoided building bridge piers on fault line, discovered by core drilling at old stream crossing about 300 ft to south.



is 4.1 miles as compared with 5.7 miles for the old, a saving of 1.6 miles.

From an operating standpoint, however, the value of the Allatoona relocation is seen more clearly from a study of Fig. 1. In 1944 the railway made a 2.5-mile relocation in connection with the reconstruction of the Etowah River bridge. While this change by itself eliminated 212 deg of curvature and 0.7 mile in distance, and corrected the bad situation of having a speed-restricted bridge at the beginning of a three-mile grade, the full value of either change by itself is greatly increased by the combination of the two projects. Unrestricted speed territory has now been projected southward toward Atlanta for a distance of approximately ten miles by these two projects.

The construction of the Allatoona relocation involved approximately 1,600,000 cu yd of common excavation and borrow, 150,000 cu yd of rock excavation, 80,000 cu yd of riprap and rockfill, a three-span bridge, 2,800 lin ft of culvert pipe, ranging in size from 24 to 84 in. in diameter, and several small concrete structures, such as retaining walls, box culvert extensions, and catch basins. The total cost of the project will exceed $1,720,000.

Three-Span Bridge Built on Dry Land

Spanning Allatoona Creek is a three-span through plate-girder structure, each span 115 ft in length. The two piers are 90 ft high from the bottom of footings to caps, rest on bedrock, and have a dumbbell section to save concrete. Both abutments are "bank type," each resting on 34 steel H-piles driven through 70 ft of compacted earthfill to bedrock. To facilitate construction and to avoid a fault in the bedrock which was discovered by core drilling where the railroad crosses the original stream channel, the bridge was built on dry land about 300 ft to the north of this crossing. When the piers were complete, the creek channel was diverted so as to pass under the bridge. A through plate-girder design was used to provide the greatest possible freeboard between the high water level of the reservoir and the low steel on the bridge, and still utilize the economical design of the approach embankments.

A variety of soils was encountered in the cuts and borrow pits on this project, ranging from silts to fire clays. The most abundant soil was a light, fluffy micaceous clay loam, generally classed as poor embankment material. It was decided that this poor material would be used only in the center of the embankments, as a "core," and to blanket the exterior with more desirable clay soils or rock spalls. In addition to safeguarding the fills from slides, this blanket will greatly reduce erosion of the slopes. Rigid moisture control and soil inspection were exercised; and tests prove that most of the embankments are compacted to 95 percent according to the Standard Proctor Test.

70-Ft Fills Seeded with Grass

Embankment slopes outside the reservoir are $1^1/_2$:1 for fills up to 50 ft in height with an 8-ft berm 25 ft below the subgrade. For fills higher than 50 ft, the slopes are 2:1 from ground elevation to 50 ft below subgrade and $1^1/_2$:1 from this point to subgrade, with berms at each 25- and 50-ft level below the subgrade. The berms are of value both in stabilizing slopes against slides and in reducing erosion. Italian rye and sericea were sown on these embankments last spring and a good cover of grass has resulted. Inside the reservoir the embankment slopes are $2^1/_2$:1 from ground elevation up to the average pool elevation; 2:1 from the average pool elevation to the 50-year-flood expectancy level; and $1^1/_2$:1 from this elevation to subgrade. There is an 8-ft berm at each change of slope, and the slopes are protected from possible wave damage by a 3-ft-thick blanket of dumped riprap up to the 50-year-flood-expectancy level. The slopes of the earth cuts are $1^1/_2$:1, and in rock vary from 1 on 1 to $^1/_4$ on 1, depending on the degree of weathering of the rock.

Earth embankments at Allatoona Bridge slope down from the cone point on a 1:1 slope, and the rockfill on a $1^1/_2$:1 slope. These slopes give the rockfill a slanted conical section, varying in thickness from approximately 30 ft at the bottom to 3 ft at the top. The rockfill is keyed into bedrock, and is designed to prevent the scouring of the approach fills by any possible velocity of the water passing under the bridge from floods or manipulation of the reservoir. The riprap and rockfill were obtained from the rock cuts.

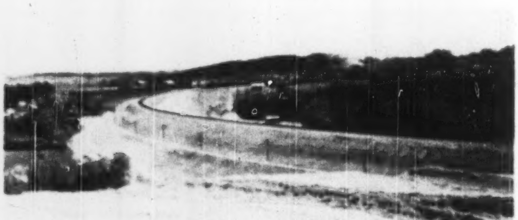
On embankments the top 2 ft of roadway was stabilized by mixing 20 percent sand, obtained locally, with a desirable clay soil, and rolling the mixture to compaction. A 6-in. layer of porous subballast was applied on the finished subgrade and well compacted. In two cuts where the soil at subgrade was of questionable stability, this soil was excavated for a maximum of 4 ft below subgrade and backfilled with subballast. These practices will reduce the high maintenance costs which normally occur during the "seasoning" of new track.

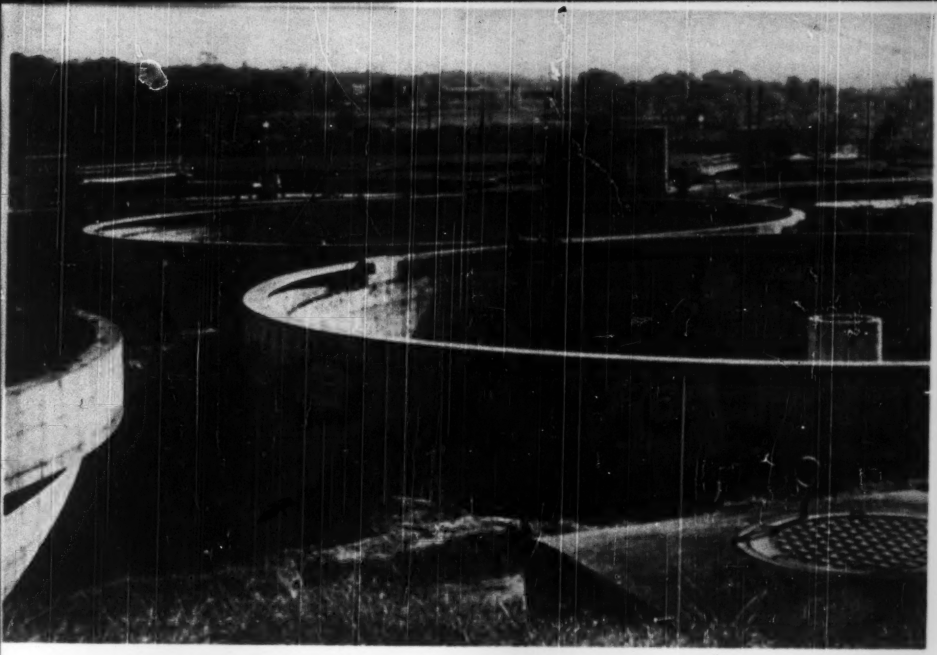
The location, design and construction of the project were carried out by the Engineering Department of the N.C. & St. L. Railway, lessee, under the general supervision of the Georgia Public Service Commission.

(Continued on page 55)

NEW RAIL ALIGNMENT crosses old track 12 ft above original grade. New track is on 0.7-percent grade. Temporary ballast track in immediate foreground is on 2.0-percent grade. New county road in left foreground was built by C. & St. L. Railway

LONG, HIGH FILL for railroad relocation has berms at 25-ft intervals along both sides of embankment. Slopes have been seeded. Three-unit diesel freight train headed for Chattanooga (to left in this view) stands on old main line track in left background





ADDITIONAL SEDIMENTATION TANKS under construction for District of Columbia's sewage treatment plant will not only serve District but also suburban areas in Maryland. Such close cooperation is typical of excellent relations that exist between member states of Potomac Valley Conservancy District.

Potomac Valley Conservancy District Takes the Offensive Against Pollution

HAROLD A. KEMP, M. ASCE

Director of Sanitary Engineering, District of Columbia, Washington, D.C.

ABATEMENT OF STREAM POLLUTION through cooperation is making great strides in the Potomac Basin. Here a commission representing four states, the District of Columbia and the President of the United States, is working without any legal enforcement powers, yet is getting active cooperation from state and county governments, local communities, farmers and industrial interests in relieving the load of pollution which formerly reduced the Potomac River to the condition of a public sewer. In this article, based on his paper delivered at the Sanitary Engineering Division session in Washington, D.C., Mr. Kemp explains how the Commission works and lists many good results already achieved, plus numerous promising plans for the future.

SOIL POLLUTION became a problem in the Potomac as early as 1863 and by 1905, when the first water filtration plant was placed in operation by the City of Washington, the problem had reached major proportions. Pollution from domestic sewage, which was a nuisance only in isolated locations in 1870, became a generally recognized health menace about the turn of the century, and a serious problem after the first World War.

Many groups and individuals have given considerable time and effort toward the abatement of this pollution on a basin-wide plan. In 1937 the Rivers and Harbors Committee of the Washington Board of Trade suggested the creation of a special body to give publicity to, and aid in, elimination of pollution in the Potomac River and its tributaries. Sparked by the Board of Trade and the Council of State Governments, Congress in 1940 granted consent to the States of Maryland and West Virginia, the Commonwealths of Virginia and Pennsylvania, and the District of Columbia, as signatory bodies, to enter into a compact for the creation of a Potomac Valley Conservancy District and the establishment of the Interstate Commission on the Potomac River Basin.

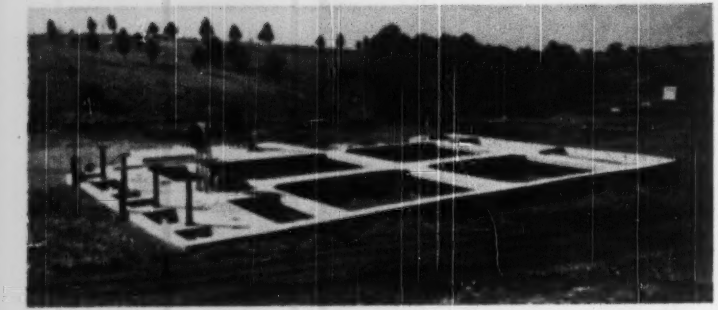
This commission consists of three members from each signatory body and three appointed by the President of the United States. Its duties under the compact are listed in the box on page 36.

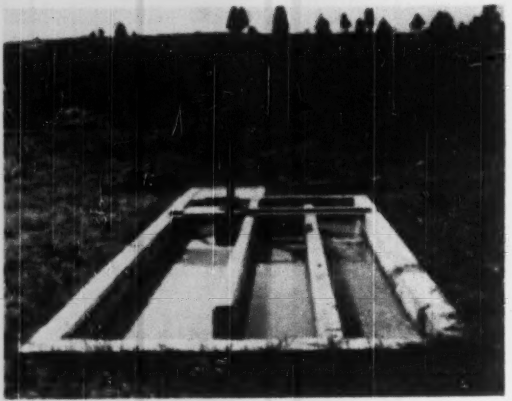
The parties signatory to the compact mutually agree to:

1. Faithful cooperation in the abatement and control of pollution in the streams of the Conservancy District.
2. Enactment of adequate and, in so far as practicable, uniform legislation for the abatement and control of such pollution.
3. Appropriation of funds to finance the operations of a coordinating agency.

The imminence of war in 1941 made it unwise to embark on an extensive program at that time. However, a survey of the sanitary condition of the Potomac was undertaken, and a preliminary but comprehensive report was issued in the fall of 1943. Intensive studies also were made of federal and state pollution legislation and the possibility of establishing water quality criteria, all with the view of obtaining uniform pollution control in the various states of the basin.

By the end of World War II, the Potomac, in the Luke-Cumberland area, had degraded to septic or cesspool quality, and in the Washington metropolitan area to an oxygen content of less than 2 ppm at low flows. Subsequently, the oxygen content of





TREATMENT OF INDUSTRIAL WASTE in flocculation and sedimentation tanks (above) at Middleway, W. Va., helps prevent overload of pollution in Potomac which is constant threat to District's water supply. These tanks, like chlorine contact chamber and effluent meter (photo at left), are part of treatment plant of Virginia Woolen Co.

the river at Washington reached a minimum of less than $^1/_2$ ppm. Pollution to a lesser degree occurred in many of the tributaries.

Just prior to the end of the war, the Commission adopted a program for the abatement of pollution and an expansion of its services. By the end of 1946 additional funds were available and committees were then enlarged, new committees formed, sampling stations established, and water quality criteria adopted. Today the Commission's budget is $27,800 and may be increased by about $10,000 during the coming year. The funds are expended on the staff, quarters, publicity and meetings. The Commission has no enforcement powers; these are reserved by each signatory body.

Organization of Commission

An understanding of the internal structure of the Potomac River Basin Commission is necessary to perceive the tangible and intangible benefits it affords to the signatory bodies. Although there are only 18 Commissioners, there are about 60 other members in responsible positions throughout the signatory states on the technical, industrial, local government and land committees. The meetings are open to the public and persons with special interests may attend as invited guests.

All aspects of each pollution problem are thoroughly investigated by the various committees. Recommendations are then made by these committees which, if approved by the Commission, are morally but not legally binding on the signatory bodies. For example, the Potomac River above Key Bridge in Washington and below Fort Belvoir in Virginia is zoned as suitable for swimming. Between these points in the Washington Metropolitan Area the objective is a river which will not adversely affect fish life and will be suitable for recreational boating. Maryland, Virginia and the District of Columbia are morally bound to accomplish this goal and are now cooperating in their efforts to attain this objective. The District of Columbia has started to expand its sewage treatment facilities, which will result in an ultimate expenditure of about $11,500,000. Also, suburban communities are preparing plans for the extension of existing facilities and the construction of new ones.

While the obvious and public actions of the Commission, its committees and guests are of great benefit to the signatory bodies, they are only a part of the many factors stimulating the abatement of pollution. Commission members, committee members and guests meet at least three times yearly for two or three days of close association at various places in and near the Potomac River Basin. Attendance of wives is encouraged in every way possible. True friendship among all members is an absolute necessity for the Commission and shows results. Regular participants have every chance to learn the specific problems of other jurisdictions. In this friendly atmosphere, many of the plans and most of the strategy are formulated, resulting in quicker action toward the solution of the complicated problems involved.

No matter what plans are made or what strategy is developed, public support must finally be obtained. For this reason, the Press is invited to attend the meetings of the Commission and is encouraged to participate in the monthly meetings of the Public Relations Committee held in Washington. The coverage given the Commission is excellent.

The Potomac River from Hains Point in Washington downstream to Fort Belvoir in Virginia will assimilate a pollution load equivalent to 475,000 persons during low summer flows and maintain itself in a satisfactory sanitary condition. The present population of the Washington Metropolitan Area is about 1,400,000 with an insignificant amount of industrial wastes. Present treatment removes the pollution equivalent of about 400,000, leaving a pollution load of 1,000,000 persons discharged into the river. This represents an overload of 525,000.

It is estimated that the population of this area will reach 1,940,000 by 1980. Yet the river will be able to assimilate no greater load than at present. Therefore future treatment must remove 75 percent of the B.O.D. in order to maintain a satisfactory condition in the river. It is anticipated that all communities in the area will continue to cooperate in attaining this goal. It should be noted here that regardless of the degree of sewage treatment, the tidewater Potomac River from Key Bridge downstream to Fort Washington in Maryland, a stretch of about 15 miles, cannot be made suitable for unrestricted recreation. This is a penalty residents of the area must pay for living in a congested community.

The District of Columbia's sewage treatment plant is now being enlarged by the installation of additional sedimentation and digestion tanks at a

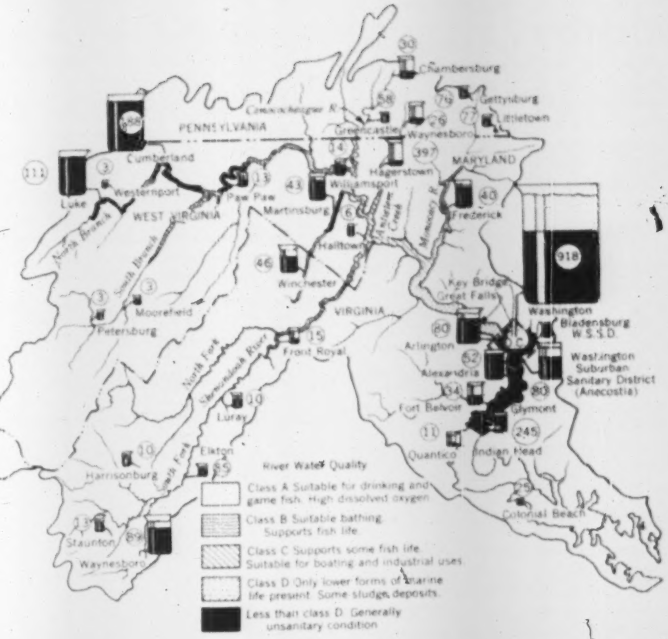
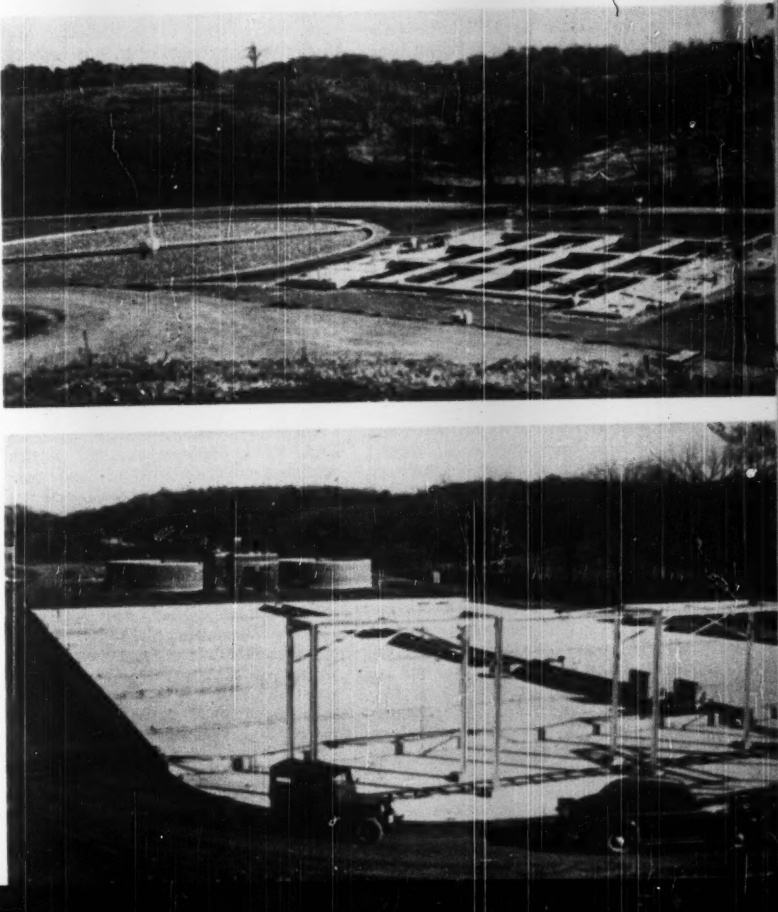

PENNSYLVANIA
WEST VIRGINIA
MARYLAND
VIRGINIA
Conococheague R.
North Branch
South Branch
North Fork
South Fork
Shenandoah River
Antietam Creek
Monocacy R.
D.C.
688
111
Luke
3
Cumberland
Westernport
13
Paw Paw
43
Williamsport
14
Martinsburg
6
Halltown
46
Winchester
3
Moorefield
3
Petersburg
15
Front Royal
10
Luray
10
Harrisonburg
Elkton
85
13
Staunton
89
Waynesboro
30
Chambersburg
58
Greencastle
26
Waynesboro
79
Gettysburg
77
Littletown
397
Hagerstown
40
Frederick
918
Key Bridge
Great Falls
Washington
Bladensburg
W.S.S.D.
80
Arlington
52
Alexandria
34
Fort Belvoir
80
Washington
Suburban
Sanitary District
(Anacostia)
Glymont
11
Quantico
245
Indian Head
25
Colonial Beach
River Water Quality
Class A Suitable for drinking and game fish. High dissolved oxygen
Class B Suitable bathing. Supports fish life.
Class C Supports some fish life. Suitable for boating and industrial uses
Class D Only lower forms of marine life present. Some sludge deposits.
Less than class D. Generally unsanitary condition

FIG. 1. **BEAKERS IN MAP** (at right) indicate main sources of pollution in Potomac River Basin. In beakers, clear fluid represents that part of pollution load removed by treatment, and size of liquid area is proportional to sewered population equivalent, given in thousands of population. Source of data is Report on Existing Conditions in Potomac River Basin, published by Interstate Commission on Potomac River Basin, November 2, 1943.

cost of about $1,500,000. The construction of sludge drying and incinerating facilities is expected to be started in 1951. Upon completion of drying and incinerating facilities the installation of secondary treatment will be considered. For years chemical treatment seemed most advantageous but the rising cost of chemicals, the difficulties of procurement and delivery for the short summer season, and the large unexpected increase in population tipped the scales in favor of an aeration process. The District is now considering the construction of an aeration plant in three stages. At a moderate increase in cost, a full activated sludge process can be adopted when needed. The plant will be designed to handle the anticipated 1980 pollution load of 1,500,000 people.

This represents a fine demonstration of cooperation between two different jurisdictions, the Washington Suburban Sanitary Commission in Maryland and the District of Columbia. Their engineers have labored long and hard and are in substantial agreement on engineering and economic fundamentals. Both agencies are sacrificing for the over-all good of the metropolitan area.

At the time the Washington Suburban Sanitary Commission constructed its primary treatment plant in Bladensburg along the Anacostia River, it was contemplated that an activated sludge process would be installed in a few years which would meet all requirements until 1965. The war intervened and populations soared so that at present more people live in the area than was expected by 1965. Since no known type of practical treatment could maintain the Anacostia River in a suitable sanitary condition (the summer flow is too low to assimilate the effluent), the District is making all its facilities available to the Washington Subur-



FILTER AND PRIMARY SETTLING TANKS (upper view) and sludge digesters and drying beds (lower view) are included in new sewage treatment plant at Winchester, Va., which forms part of pollution elimination program for stretch of Potomac between Key Bridge and Great Falls, a stretch set aside for recreation.

ban Sanitary Commission in Maryland at cost. At such time as the District's interceptor becomes inadequate, the two jurisdictions will bear their proportional share of the cost of increasing its capacity. Savings which will accrue to the Sanitary Commission by the lower cost of handling and treating its sewage by the District will wipe out its investment in the Bladensburg plant in about 15 years.

The metropolitan areas in Virginia are expected to reach a population of 440,000 by 1980. Arlington County plans to extend its existing plant and Alexandria has prepared plans for a new plant. Both can be enlarged to meet future growth. Fairfax County is now preparing plans for an 8-million gal plant serving a 30-sq mile area adjoining Arlington and Alexandria, and is also studying complicated sewage handling and treatment problems in other sections of the county.

One Section Reclaimed for Recreation

The Potomac above Key Bridge is the only section of the river that can be reclaimed for unrestricted recreational use in the Metropolitan Area. It is an intangible but priceless asset and can be secured at reasonable cost. There, within the actual limits of the District and adjacent suburban communities in Maryland and Virginia, parks and parkways are being constructed which will open recreational areas unexcelled within a congested community. The District of Columbia also proposes to supplement its Great Falls water supply by taking water from this section of the river. It becomes obvious that the health hazard must be removed from the river. This can only be done by eliminating all pollution between Key Bridge and Great Falls.

Upstream communities, such as Frederick and Hagerstown, Md., Winchester, Va., and others have at present, or will soon provide, adequate treatment facilities thus ensuring safe water at Great Falls. In addition raw sewage must not be discharged into the stretch of the river between Great Falls and Key Bridge nor should effluent from a sewage treatment plant be permitted to discharge into it. The Washington Suburban Sanitary Commission is now contemplating the construction of an interceptor sewer which will discharge into the District of Columbia sewer system. Suburban communities in Virginia are also studying the problem and will cooperate in removing sources of pollution from this stretch of the river.

The Surgeon General of the U.S. Public Health Service stated in 1925 that. "A factor of the bathing problem not considered in this report, and which has a very direct bearing on the problem of health protection, is the turbidity of the river. Turbid waters, such as exist in the Potomac, are dangerous for bathing as a drowning person cannot be seen in time to have assistance rendered him. In this respect, pools filled with clear, filtered water are much safer for bathing than is a turbid river."

Duties of Interstate Commission on Potomac River Basin

1. To coordinate, tabulate, and summarize existing data on the pollution, character, and condition of the streams of the Conservancy District.

2. To supplement existing data, if necessary, by conducting investigations.

3. To promote adoption by the signatory bodies of uniform legislation for the control of stream pollution.

4. To disseminate information to the public on the effects of stream pollution and the objectives of the Commission.

5. To cooperate with other organizations in, and conduct, if advisable, studies of treatment methods for sewage and industrial wastes.

6. To recommend to the signatory bodies standards for cleanliness of streams.

What a pity, if after accomplishing the Commission's aims with respect to organic pollution, the river could not be used for recreation because of turbidity! Soil losses above Washington are so extensive that the silt passing Washington exceeds 1,700,000 tons yearly. At times of large floods, the water filtration facilities must handle turbidities up to 6,000 ppm. The Interstate Commission on the Potomac River Basin, soil conservation interests, and the farmers are cooperating in reducing this waste soil load. The Monocacy River is the muddiest of the Potomac's tributaries. Its basin has been adopted for intensive soil conservation work in order to evaluate benefits. The interest and energy displayed by farmers assures success. The program is expected to be expanded to cover the entire Potomac River Basin.

Natural pollution in the form of decay of vegetation and marine growths imparts tastes and odors to the river water which may become obnoxious to consumers of treated river water during long sustained cold spells. During February of 1948, the river was covered with a solid sheet of ice for a period of about 40 days. The oxygen in the water was consumed and new oxygen could not be absorbed from the air. An epidemic of complaints followed, which reached its peak during a thaw when ice floes literally scoured the river bottom and banks. No one can prevent this type of pollution, but the Washington Aqueduct, which supplies water to the District of Columbia and other metropolitan areas, has installed additional chlorine and chlorine dioxide facilities, among others. Their value should be demonstrated during the next prolonged cold spell.

Industrial wastes which are discharged into the streams of the basin have little effect on the water entering or leaving the Washington Metropolitan Area. Other locations, however, are not so fortunate. From Luke, Md., on the North Branch of the Potomac River, downstream to Cumberland, Md., a distance of about 35 miles, the industrial waste load is about five times that of the population residing in the area. For long stretches all oxygen is depleted and nowhere is the water suitable for use. The North Branch and its tributaries are plagued with about 170,000 lb of acid per day from abandoned and active coal mines. Long stretches are devoid of any fish or plant life. Other areas polluted by industrial wastes are Luray and Front Royal, Va., on the South Fork of the Shenandoah River; Waynesboro, Va., on South River; Martinsburg, W. Va., and Winchester, Va., on Opequon Creek.

Every major type of industry is represented on the Industrial Committee of the Commission and these representatives are giving full cooperation in solving many complex problems. An excellent library has been established and a brochure has been issued on waste treatment. Industry as a whole has and is voluntarily reducing its pollution load on the streams in the basin.

The lower Potomac is generally in good sanitary condition. Fort Belvoir, Quantico and Colonial Beach in Virginia, and Glymont in Maryland, treat their sewage. Indian Head in Maryland is discharging some untreated wastes to the river but corrective steps are planned. The principal threat in the lower river is damage to the oyster beds by excessive turbidity and mud deposits. Mosquito control has been effective and the water chestnut, which at one time nearly covered the entire surface of the lower river, has been almost completely eradicated.

(*Continued on page 86*)

Delaware Aqueduct Metering and Control Equipment Incorporates Many New Features

WALTER J. GRESS, M. ASCE

Designing Engineer, Board of Water Supply, New York, N.Y.

THROUGH THE decades, New York City has endeavored to reach that apparently unattainable goal, an adequate supply of wholesome water (Fig. 1). As shown in Fig. 2, the rise in dependable yield has been closely followed and at times exceeded by the rate of consumption. During the last four years the average yearly increase in the daily rate of water consumption has been about 45 mgd. To quench this unappeased thirst, the development of the Delaware water supply was initiated (CIVIL ENGINEERING, February 1949). The advancement of this project has been seriously delayed by the depression and World War II, and its adequacy for future needs is in question even before its completion. The replacement of blighted tenement areas with large housing projects, the expanded use of improved sanitary facilities, the development and general use of new water-consuming appliances and the rise in population are the principal factors in the race to keep abreast of the demand for potable water.

The relative safety of operating within 90 percent of the dependable yield has been experienced by the city of New York for rather short intervals in its past. This lack of adequate water insurance, coupled with periods of subnormal rainfall, has threatened the metropolitan area with water shortages such as the present one. The general public and many responsible individuals fail to realize that the impact of a real water famine upon the health, economy and survival of a city such as New York would exceed the ravages of the highly publicized atomic weapon. The pressing need for the additional resources of the Delaware system is apparent. Among the many interesting phases of this large undertaking is the metering equipment to be installed in the control or effluent chambers, which form the subject of this article. These chambers will measure and treat the water from the many reservoirs in the city system and control its delivery to the municipal area.

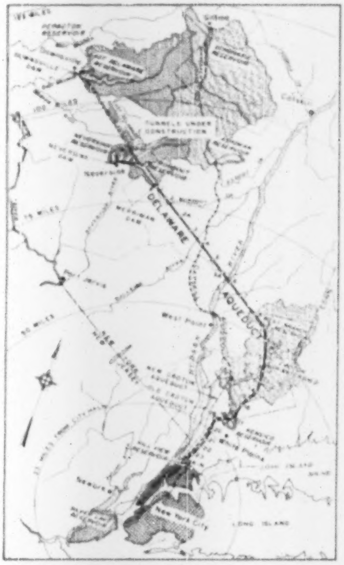


FIG. 1. **THREE MAIN systems comprise New York's water supply—completed Croton and Catskill systems, and Delaware Aqueduct, started in 1937 and still under construction. Metering and control chambers interconnect these three systems. Numbered circles on Delaware Aqueduct, represent shafts. Emergency plant to lift 100 mgd of Hudson River water 600 ft into Delaware Aqueduct at Shaft No. 6 is in planning stage.**

In the expansion of New York's water resources, the existing Croton and Catskill systems will be supplemented by and integrated with the new Delaware system. The diagrammatic plan shown in Fig. 3 indicates the coordination of the high-level systems, the capacities of the reservoirs and aqueducts, the safe yields and the extensive metering required in their operation. The limited capacity of the Catskill Aqueduct reveals it as the bottleneck in the present crisis. The demand of approximately 1,200 mgd cannot be sustained for long by a capacity of 650 mgd plus the reserve stored in Kensico Reservoir. The second item of interest in view of the rising demand is the rather small capacity of Hillview Reservoir, indicating a rapid approach to obsolescence.

The main flow control points of each of the three sections of the Delaware Aqueduct, the 85-mile tunnel between Rondout and Hillview, are located at the inlet ends of the tunnels. The primary function of the effluent chambers is to provide a wide range of quantities in variable increments up to the nominal capacities of their respective tunnel sections. This function, plus the problem of dissipating excess energy from a head of 340 ft at Rondout and of 150 ft at West Branch, influenced the design and arrangement of the control and metering equipment in the effluent chambers at these locations as shown in Figs. 4, 5 and 6. A single Venturi meter in the downtake shafts would not be dependable because of surge conditions that would develop at the lower range of flows. The system of multiple, short, nozzle-type Venturi meter tubes without the conventional diverging section, was adopted because head recovery is unimportant, and a less expensive substructure was required. The Rondout, West Branch and Kensico South effluent chambers are, figuratively speaking, huge valves that screen the water, control and measure its flow, and treat it with chlorine.

In the operation of these three chambers, regardless of the quantity, all the waterways leading into the forebay must have their sluice gates—or selected ports in the case of Rondout—fully open. Flow is controlled by sluice gates and valves on the downstream side of the forebays.

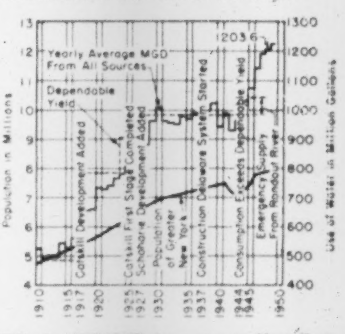


FIG. 2. **DEMAND for water in New York grows faster than new sources can be tapped. Subnormal rainfall this year threatens city with water famine. Reservoirs are but one-third full.**

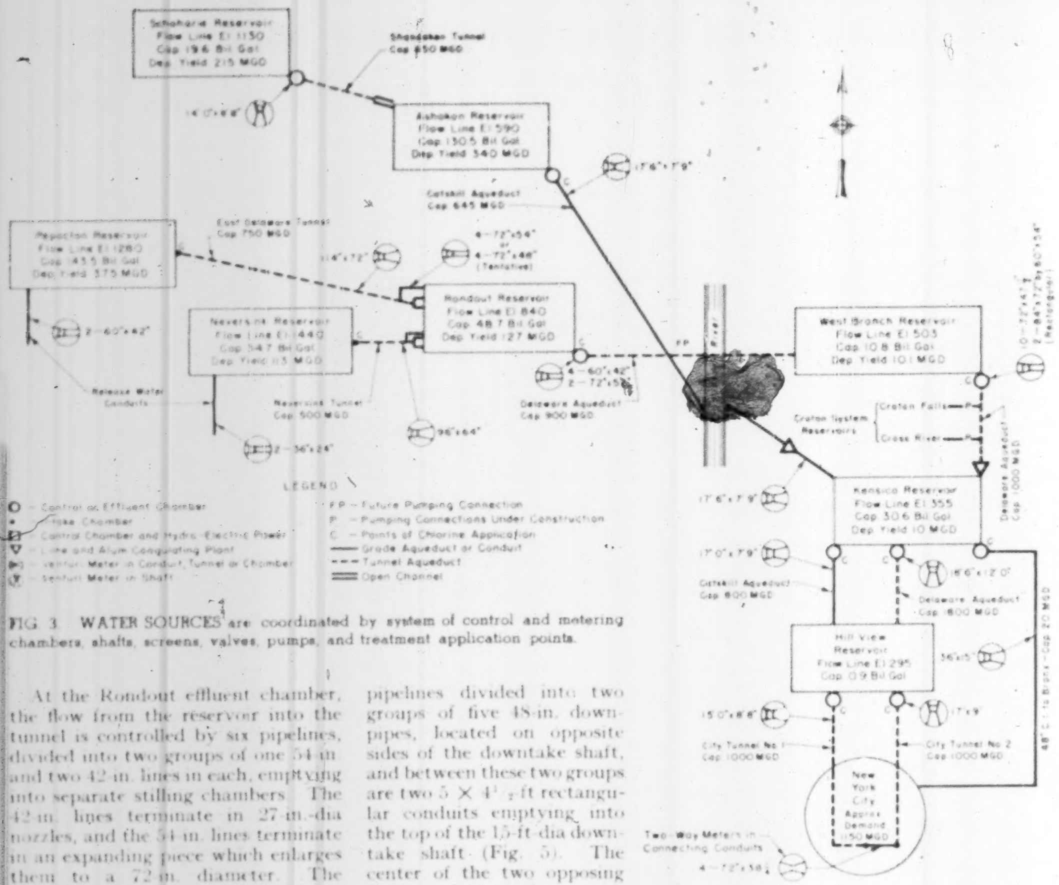

Schoharie Reservoir
Flow Line El 1130
Cap 19.6 Bil Gal
Dep Yield 215 MGD
Shandaken Tunnel
Cap 650 MGD
14'0"x8'8"
Ashokan Reservoir
Flow Line El 590
Cap 130.5 Bil Gal
Dep Yield 540 MGD
17'6"x7'9"
Catskill Aqueduct
Cap 645 MGD
Pepacton Reservoir
Flow Line El 1280
Cap 143.5 Bil Gal
Dep Yield 375 MGD
East Delaware Tunnel
Cap 750 MGD
114"x72"
4 – 72"x54"
or
4 – 72"x48"
(Tentative)
Rondout Reservoir
Flow Line El 840
Cap 48.7 Bil Gal
Dep Yield 127 MGD
2 – 60"x42"
Neversink Reservoir
Flow Line El 1440
Cap 34.7 Bil Gal
Dep Yield 113 MGD
Release Water
Conduits
Neversink Tunnel
Cap 500 MGD
96"x64"
2 – 36"x24"
4 – 60"x42"
2 – 72"x52"
Delaware Aqueduct
Cap 900 MGD
FP
River
West Branch Reservoir
Flow Line El 503
Cap 10.8 Bil Gal
Dep Yield 10.1 MGD
10 – 72"x47"
2 – 84"x72" by 60"x54"
(Rectangular)
Croton System
Reservoirs
Croton Falls
Cross River
Delaware Aqueduct
Cap 1000 MGD
17'6"x7'9"
Kensico Reservoir
Flow Line El 355
Cap 30.6 Bil Gal
Dep Yield 10 MGD
17'0"x7'9"
Catskill Aqueduct
Cap 800 MGD
18'6"x12'0"
Delaware Aqueduct
Cap 1800 MGD
Hill View
Reservoir
Flow Line El 295
Cap 0.9 Bil Gal
36"x15"
48" C.I. to Bronx – Cap 20 MGD
15'0"x8'8"
17'x9'
City Tunnel No 1
Cap 1000 MGD
City Tunnel No 2
Cap 1000 MGD
New
York
City
Approx
Demand
1150 MGD
Two-Way Meters in
Connecting Conduits
4 – 72"x38¼
LEGEND
Control or Effluent Chamber
Intake Chamber
Control Chamber and Hydro-Electric Power
Lime and Alum Coagulating Plant
Venturi Meter in Conduit, Tunnel or Chamber
Venturi Meter in Shaft
FP – Future Pumping Connection
P – Pumping Connections Under Construction
C – Points of Chlorine Application
Grade Aqueduct or Conduit
Tunnel Aqueduct
Open Channel

FIG. 3 **WATER SOURCES** are coordinated by system of control and metering chambers, shafts, screens, valves, pumps, and treatment application points.

At the Rondout effluent chamber, the flow from the reservoir into the tunnel is controlled by six pipelines, divided into two groups of one 54-in. and two 42-in. lines in each, emptying into separate stilling chambers. The 42-in. lines terminate in 27-in.-dia nozzles, and the 54-in. lines terminate in an expanding piece which enlarges them to a 72-in. diameter. The conical plug valve controls are so arranged that the 42-in. valves can be opened in any sequence desired but the two pairs of 54-in. valves, operating together, cannot be opened until all 42-in. valves are open. The range of flows obtained by this method of control for certain flow-line elevations is given in Table I.

In addition to the flow-control system described, the Rondout Reservoir outlet chamber is equipped with a blow-off line to feed water into the stream below the dam if required. A 24 × 19½-in. nozzle-type Venturi tube is located in the line and it has the usual transmitter and dial indicator equipment. As the use of the blow-off will be intermittent, such discharges when they occur will be registered on a strip chart recorder located in the valve control cabinet.

At the West Branch effluent chamber, the flow from the reservoir into the tunnel connecting to Kensico Reservoir is controlled by twelve pipelines divided into two groups of five 48-in. downpipes, located on opposite sides of the downtake shaft, and between these two groups are two 5 × 4½-ft rectangular conduits emptying into the top of the 15-ft-dia downtake shaft (Fig. 5). The center of the two opposing groups of downpipe terminals is located about 50 ft below the flow line of Kensico Reservoir in an enlarged portion of the shaft (Fig. 6). The downpipe outlets are bronze nozzle castings each having a pair of converging 16-in.-dia nozzles. The 48-in. valves are interlocked so that pairs of jets issuing from opposite sides of the shaft meet in its center. The controls are arranged so that any one of the ten valves can be the first to be opened, followed by its mate on the opposite side. Then any other pair can be similarly opened until all ten valves are open. At this point the two rectangular valves, operating together, may be opened if the water in the downtake shaft has risen to a selected elevation at which cataracting is unlikely to occur. The quantities obtained for a given flow-line condition are given in Table II.

In both chambers, valves are operated electrically with the control housed in cabinets located at the main floor level. Valves are operated fully open or entirely closed.

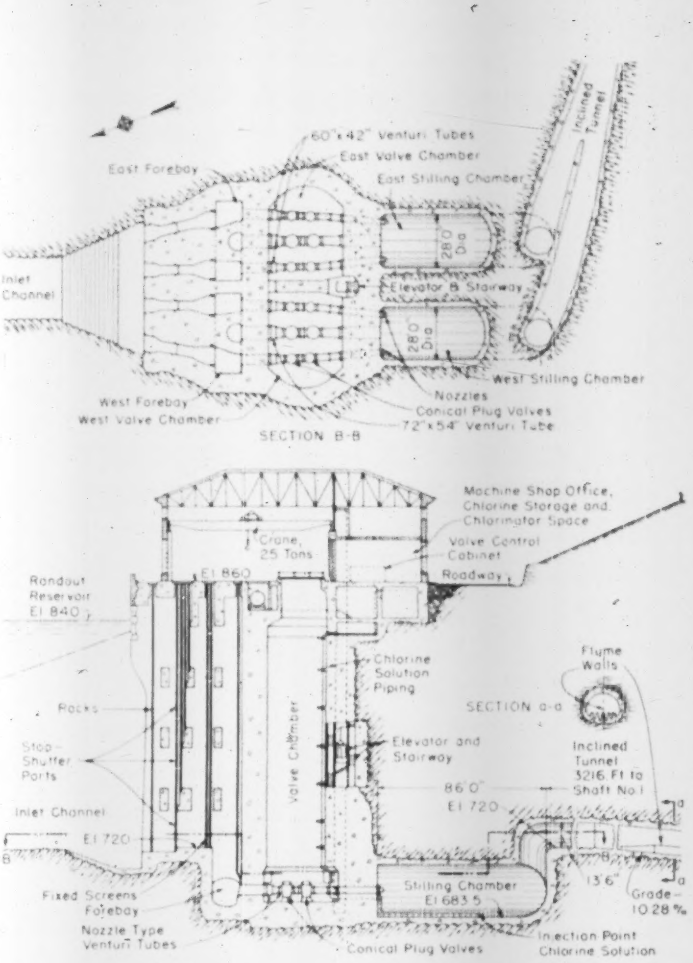
The third and largest control chamber of the Delaware Aqueduct, the

TABLE I. RANGE OF FLOWS OBTAINED AT RONDOUT EFFLUENT CHAMBER

Rondout Reservoir, El. 840; West Branch Reservoir, El. 503; Tunnel, C = 120 (Williams & Hazen)

Lines Operating		Throat Velocity	Q in mgd	Total Q	Surface El. in Downtake
No.	Size	f/s	per Line	mgd	Shaft
1	42 in.	33.4	208.0	208	528.5
2	42 in.	33.0	206.0	412	[illegible]
3	42 in.	33.1	206.6	620	[illegible]
4	42 in.	30.3	189.0	756	[illegible]
4	42 in.	9.6	60.0	894	824.5
2	54 in.	31.8	327.0		

FIG. 4. EFFLUENT from Rondout Reservoir will be measured (up to 900 mgd) by four 60-in. and two 72-in. Venturi meters discharging through inclined tunnel to shaft No. 1 (see Fig. 1) of 45-mile Delaware Aqueduct tunnel to West Branch Reservoir.



60"x42" Venturi Tubes
East Valve Chamber
East Forebay
East Stilling Chamber
Inclined Tunnel
Inlet Channel
28'0" Dia
Elevator & Stairway
28'0" Dia
West Stilling Chamber
West Forebay
Nozzles
West Valve Chamber
Conical Plug Valves
72"x54" Venturi Tube
SECTION B-B
Machine Shop Office, Chlorine Storage and Chlorinator Space
Crane, 25 Tons
Valve Control Cabinet
Roadway
Rondout Reservoir El 840
El 860
Chlorine Solution Piping
Flume Walls
SECTION a-a
Racks
Valve Chamber
Elevator and Stairway
Stop-Shutter Ports
Inclined Tunnel 3216 Ft to Shaft No. 1
86'0"
El 720
Inlet Channel
El 720
B
B
a
a
13'6"
Stilling Chamber El 683.5
Grade-10.28%
Fixed Screens
Forebay
Nozzle Type Venturi Tubes
Conical Plug Valves
Injection Point Chlorine Solution

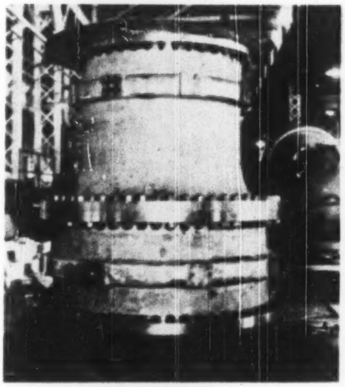
Kensico South effluent chamber, will be described in a subsequent article. The metering equipment, a model Venturi meter and its rating for this chamber were included in the contract under which similar equipment and the bronze meter tubes were furnished for Rondout and West Branch chambers.

Metering Equipment Similar in Design

The general arrangement of the metering equipment and the design of its component parts are similar at the Rondout and West Branch effluent chambers. The flow through each conduit, previously described, is registered by its individual Venturi meter and transmitted electrically to dial indicators mounted on panels of the valve control cabinets. Here also, the integrated flow through any number of lines in operation is indicated on a large dial and registered on a totalizer and chart.

The sizes of the nozzle meter tubes were determined by the range of quantities desired at each of the two chambers. However, the ratio of throat to inlet diameters was not permitted to exceed 0.75 except for the 24-in. blowoff tube at Rondout. All the pipe intakes or wall castings to which these meter tubes are attached, are made of high-strength bronze. It was decided to specify the same high-strength bronze for the nozzle meter tubes, both to attain maximum durability and to eliminate problems involving the use of bronze liners and plates at the peizometer holes which would have arisen had a ferrous metal been selected. To facilitate casting, the meter tube units were made in two parts—the entrance section, and the ellipsoidal transition and throat section—and bolted together. Table III gives the hydraulic data pertinent to the design.

Except for dimensional differences, all circular tubes are similar in design and construction. The two rectangular tubes are composed of three heavily ribbed sections, the entrance, transition and throat, bolted into a unit. The pressure chambers of the circular tubes are cast integrally with the entrance and throat castings, but in the



HIGH-STRENGTH Bronze Venturi meter tube, 60 in. × 42 in., is one of four to be installed at Rondout Reservoir. Profile of entrance section is quarter elipse.

TABLE II. RANGE OF FLOWS OBTAINABLE AT WEST BRANCH EFFLUENT CHAMBER

West Brange Reservoir, El. 503.0, Kensico Reservoir El. 355, Tunnel C = 140 (Williams & Hazen)

No. of 48-In. Downpipes Operating	Throat Velocity f/s	Q in Mgd per Downpipe	Total Q mgd	Surface El. in Downtake Shaft
1	18.6	151	151	357.7
2	18.1	147	294	364.5
3	17.6	142.6	428	374.2
4	16.8	134	546	385.1
5	15.9	129.6	648	396.5
6	15.1	122.6	736	407.7
7	14.2	115.6	810	418.0
8	13.4	109.3	875	427.5
9	12.7	103.1	928	435.8
10	12.0	97.1	971	443.0
10 48-in	6.3	50.0	1,210	487.2
2 rect	24.4	355.0		

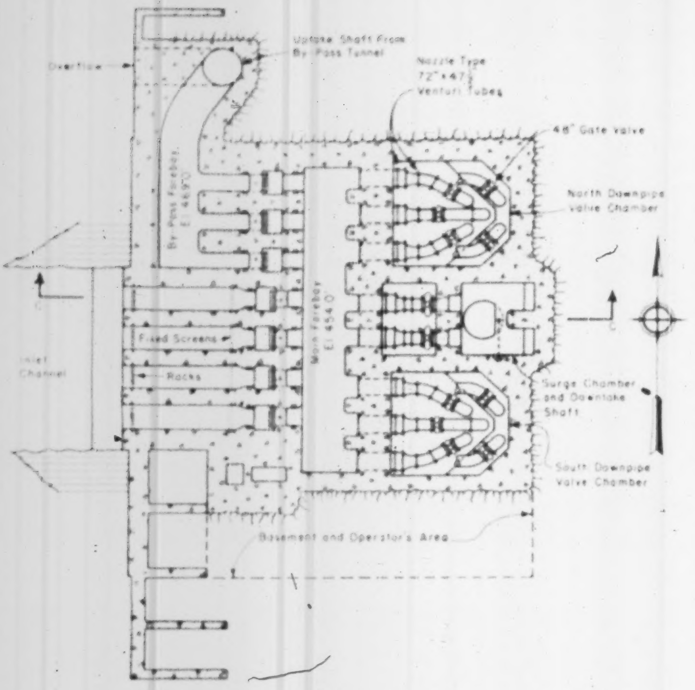

Uptake Shaft From By-Pass Tunnel
Overflow
Nozzle Type 72"×47½ Venturi Tubes
48" Gate valve
By-Pass Forebay El 469.0
North Downpipe Valve Chamber
Main Forebay El 454.0
Fixed Screens
Racks
Inlet Channel
C
C
Surge Chamber and Downtake Shaft
South Downpipe Valve Chamber
Basement and Operator's Area

FIG. 5. EFFLUENT CHAMBER and shaft at West Branch Reservoir will control 1,200 mgd through ten 48-in. downpipes and two rectangular conduits, all metered.

case of the rectangular tubes, copper pipe belts with connections to the piezometer holes are provided.

Differential Pressure Assemblies

The differential pressure assemblies or transmitters for the Rondout and West Branch chambers are of special design and are mounted on the valve chamber walls above or adjacent to the meter tubes. Each transmitter is provided with a mercury manometer having a scale reading directly in millions of gallons daily. Between combinations of instruments, space is reserved for mounting a portable water manometer to provide an immediate check on the operation and accuracy of any transmitter for its full range. These units have dial indicators, graduated from zero to 100, and the values shown are translated into mgd flow readings by applying a multiplier. The transmitters are compact, watertight, heated and illuminated by an electric light bulb. The rates of flow registered by the mercury column are electrically transmitted from the units to the individual meter tube rate-of-flow dial indicators mounted on the valve control cabinets. At the Rondout chamber the vertical distance between transmitters and dials is approximately 170 ft. The conductors of the transmission system, an electronic control circuit, are a shielded, twisted, two-wire speaker cable contained in steel electric conduits.

By incorporating the rate-of-flow dial indicators in the valve control cabinets, the operators of the chambers have been provided with means for checking the operation and condition of the different components of any line, such as the meter tube, the valve and the nozzle, all located at some distance from the point of control. The dial and switch for a particular line are grouped together and labeled by a name plate, coded for easy identification. For example at West Branch, the two valve chambers are designated by the letters "N" and "S," north and south, and the downpipes, paired in opposition, by the numerals 1, 2, 3, etc. The controls are interlocked electrically in such a manner that nothing happens until the proper switch is in its open or closed position. At Rondout the valve chamber letters are "E" and "W," designations for the east and west valve chambers.

When a valve in any given line is opened, the switch light on the panel is red and, as the flow through the meter tube begins, the flow indicator dial is illuminated. Under conditions of no flow, the switch light is green and the dial light is out, with the pointer assuming a vertical downward position. The size of the meter tube and flow unit is indicated on each dial. The flow indicators are equipped with Helipot units that are power positioned by a Holtzer Cabot motor in response to the electronic control circuit. The dial pointer is positioned by means of a magnetic clutch.

Readings on the various individual flow indicators are totaled electrically, indicated on a large dial, and registered on a counter dial-type totalizer and a 7-day circular chart. Water-surface elevations registered at various locations in the chambers are likewise indicated on the valve control panel.

Scale Model Meters Tested

Model ratings were ordered because it was felt that the nozzle-type meter tubes with the elliptical shape in the transition portion differed sufficiently from conventional meters to warrant exploratory tests. Four model Venturi meters were used in the rating tests conducted at the University of Pennsylvania by Professors W. S. Pardoe, M. ASCE, and E. F. Stover. A 12×7.917-in. model, a one-sixth scale reproduction of the 72 × 47½-in. prototype, was likewise used to determine the coefficient characteristics of the 60 × 42-in. prototype. The second model used, 8 × 6 in., was a one-ninth scale reproduction of the 72 × 54-in. prototype, and was also found suitable for

TABLE III. DESIGN DATA FOR VENTURI METER TUBES

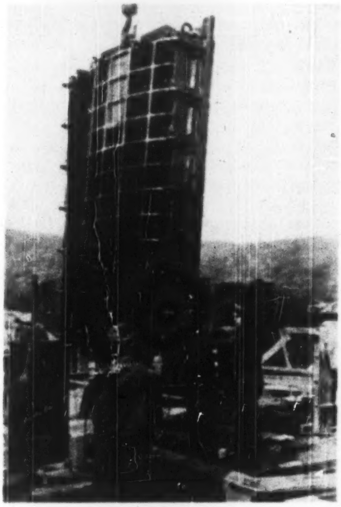
Location	No.	Size Inches	Flow Range, mgd Min	Flow Range, mgd Max	Reservoir El.	Drawdown, Ft	Tube Center Line El.
Rondout Effluent Chamber	1	24 × 19½ blow-off	10	82.5	840	100	693.0
	4	60 × 42	50	220	840	100	697.5
	2	72 × 54	268	560	840	100	697.5
West Branch	10	72 × 47½	35	220	503	20	4 at 468.75 6 at 458.75
Effluent Chamber	2	84 × 72 entrance 60 × 54 throat	250	500	503	20	460.5

the determination of the coefficient for the $24 \times 19\frac{1}{2}$-in. prototype. The third, a rectangular $10\frac{1}{2} \times 9$ by $7\frac{1}{2} \times 6\frac{3}{4}$-in. model, was rated for the rectangular meter prototype. The fourth model was a 1:18.5 scale reproduction of the Kensico Venturi meter. All models were made of the same type of bronze used in the prototypes. The Kensico tube model was made entirely of bronze although the prototype is mostly of concrete with two bronze rings. Surface conditions such as machined finishes and cast roughness were maintained similar in model and prototype.

Results showed the wisdom of ordering the model tests since the model coefficient values secured were in general lower than those customarily obtained with a conventional conical-transition Venturi meter. In addition, the tests proved that in the case of the Kensico unit, piezometers for the inlet ring had to be moved some distance upstream from the beginning of the elliptical transition in order to obtain satisfactory results.

Metering Problems Studied

Prior to the drafting of the specifications, the problems of metering at the three effluent chambers were studied in great detail and discussed with the engineers of concerns qualified to furnish such equipment. Foundry and machining problems were likewise investigated. Consequently the specifications as finally written described the equipment and instruments in considerable detail.



SLUICE GATE 6 ft x 12 ft, weighing 24,000 lb, is installed at West Branch.

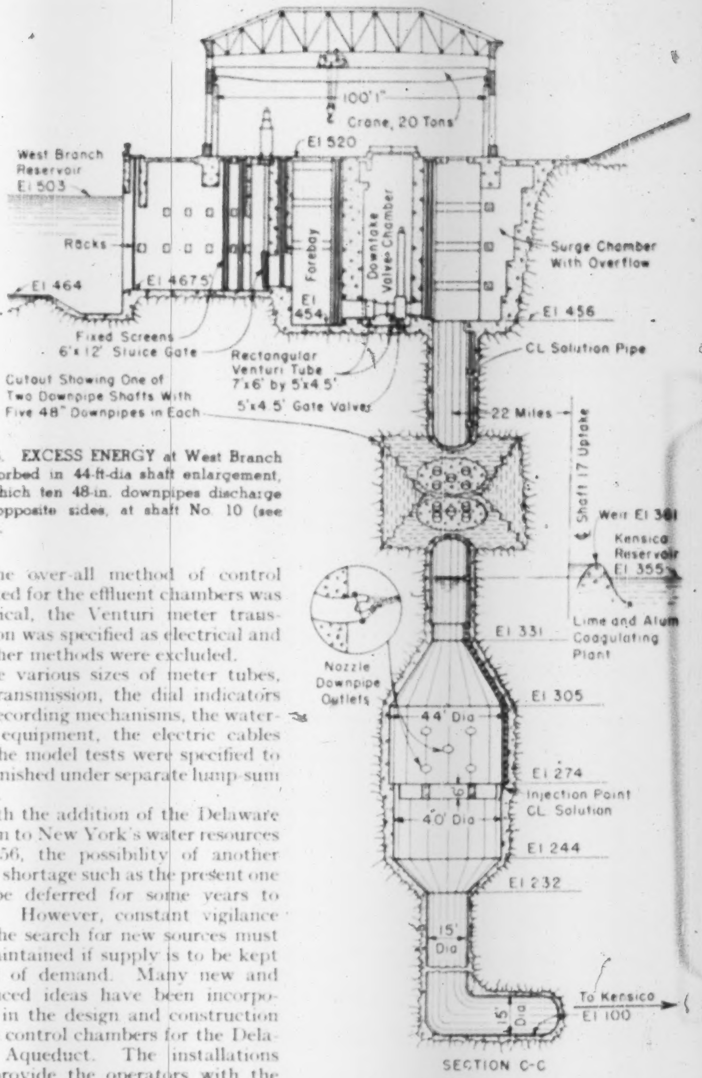

100'1"
Crane, 20 Tons
El 520
West Branch
Reservoir
El 503
Racks
El 464
El 467.5
Forebay
Downtake
Valve Chamber
El 454
Surge Chamber
With Overflow
El 456
Fixed Screens
6'x12' Sluice Gate
Rectangular
Venturi Tube
7'x6' by 5'x4.5'
5'x4.5' Gate Valves
CL Solution Pipe
Cutout Showing One of
Two Downpipe Shafts With
Five 48" Downpipes in Each
22 Miles
Shaft 17 Uptake
Weir El 361
Kensico
Reservoir
El 355
Lime and Alum
Coagulating
Plant
El 331
Nozzle
Downpipe
Outlets
El 305
44' Dia
El 274
Injection Point
CL Solution
40' Dia
El 244
El 232
15' Dia
To Kensico
El 100
15' Dia
SECTION C-C

FIG. 6. EXCESS ENERGY at West Branch is absorbed in 44-ft-dia shaft enlargement, into which ten 48-in. downpipes discharge from opposite sides, at shaft No. 10 (see Fig. 1).

As the over-all method of control adopted for the effluent chambers was electrical, the Venturi meter transmission was specified as electrical and all other methods were excluded.

The various sizes of meter tubes, the transmission, the dial indicators and recording mechanisms, the water-level equipment, the electric cables and the model tests were specified to be furnished under separate lump-sum items.

With the addition of the Delaware system to New York's water resources in 1956, the possibility of another water shortage such as the present one will be deferred for some years to come. However, constant vigilance and the search for new sources must be maintained if supply is to be kept ahead of demand. Many new and advanced ideas have been incorporated in the design and construction of the control chambers for the Delaware Aqueduct. The installations will provide the operators with the flexible system of controls necessary for the operation of such a vast water supply system.

The Venturi tubes, with their appurtenant instruments, are being furnished by the Simplex Valve and Meter Co. of Philadelphia, Pa., at a cost of \$504,450. As subcontractors, the American Manganese Bronze Co. made the bronze castings. Gordon Ewertz, consulting engineer, designed and furnished the equipment for indicating water-level elevations. S. A. Healy Co., Chicago, is building the control structure and installing the metering equipment at Rondout Reservoir. Completed cost will be about \$5,000,000.

The shaft, substructure and the control chamber at West Branch Reservoir were built under an earlier contract by the Frazier-Davis Construction Co., St. Louis. At present the same company has a contract for completion of the chamber and installation of the metering equipment. The total approximate cost will be \$4,400,000. The president of the N. Y. City Board of Water Supply is Irving V. A. Huie, M. ASCE, and the Chief Engineer, John M. Fitzgerald, M. ASCE.

Wet Silt Under Base Course Damages Alaska's Glenn Highway

MARTIN EKSE, Assoc. M. ASCE

Assistant Professor of Civil Engineering,
University of Washington, Seattle

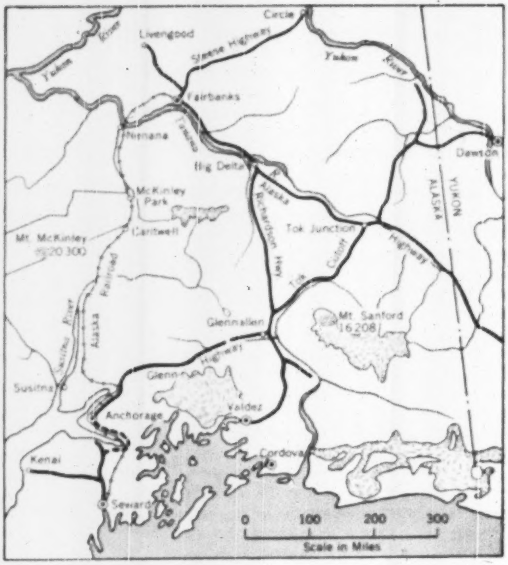


FIG. 1. GLENN HIGHWAY connects Anchorage, Alaska, with Richardson Highway about 3 miles east of Glenallen. Richardson Highway runs from Valdez to Fairbanks via North Spur at Big Timber. Connection with Alaska Highway through Whitehorse, Canada, is made at Tok Junction.

GRAY AND YELLOW SILTS found on the route of the Glenn Highway in Alaska have caused considerable damage to the road in some sections. Reconstruction of this route, which extends from Anchorage to its junction with the Richardson Highway at Glenallen, is now well under way. (See Fig. 1.) The work has been divided into four projects. Section A, extending 48 miles northeast from Anchorage, is being improved by contract under the U.S. Bureau of Public Roads. The other three sections, B1, 54 miles; B2, 44 miles; and B3, the last 43 miles to Glenallen—are being reconstructed by contract under the Alaska Road Commission.

Design of Reconstructed Highway

Contracts include grading, drainage facilities, a 4½-in. base course of crushed gravel, and 1½ in. of plant-mix bituminous mat on two 10-ft lanes with 4-ft shoulders. With these comparatively thin sections of base course and bituminous mat, it was deemed necessary to give particular attention to the use of select borrow in building up the subgrade.

A rather critical situation presented itself on Section B2, where serious breaking up of portions of the old roadway surface occurred last spring. A typical profile below the old roadway surface appears in Fig. 2, taken where the surface had broken up near the location shown in an accompanying photograph. Figure 3 shows the soil profile for the natural ground adjacent to the roadway at the same location. Sections that broke up during the spring thaw varied in length from 50 ft to nearly half a mile, and the total roadway length of such sections is about three miles. It is notable that these sections were in flat areas with practically no runoff or surface drainage because of heavy vegetative cover adjacent to the roadway.

All gray and yellow silts found in these areas have virtually the same physical properties. A typical grading is:

Passing 40-mesh sieve	100 percent
Passing 100-mesh sieve	97 percent
Passing 200-mesh sieve	86 percent
Finer than 0.0053 mm	4 percent

The liquid limit is 31 and the plasticity index, zero. The field moisture content for samples taken early in June 1949 varied from 40 to 50 percent, and by June 25 the moisture content had dropped to an average of about 26 percent under the roadway surfacing, but still remained at about 40 percent under the organic layer adjacent to the roadway.

During and after the spring thaw and until about the middle of June, the silt layer beneath the gravel surfacing was in a liquid state. The vibration even of passenger-car traffic could be felt when standing on the grade. This vibration, and the pounding of heavier truck traffic, produced a pumping action which caused the wet silt to work up through the gravel layer as illustrated in Fig. 2, thus weakening it and causing failure of the roadway.

The high capillarity of the silt makes drainage very difficult, especially in flat areas. Drying out of the silt layer was mainly dependent on evaporation through the gravel surfacing layer and the shoulders. And

TRAFFIC USES half of Glenn Highway, Alaska, while dragline excavates subgrade on other half. Section pictured broke up during 1949 spring thaw as result of pumping action (Fig. 2). Dragline removes both gravel base course and silt layer for wasting. Later road will be backfilled to new grade with select borrow. Three-mile section required 58,000 cu yd of excavation, 63,000 cu yd of borrow.

it was realized that the placing of an impervious bituminous mat over most of the roadway surface would aggravate an already bad condition.

Subgrade Excavated to Underlying Gravel

For the most part, the silt was underlaid with a gravel bed at an average depth of about 3 ft below the surface of the old roadway. It was decided to excavate the subgrade to this gravel bed or to a fine sand layer which in some places overlay the gravel. In a few places where stable material could not be reached at a reasonable depth of about 4 ft, a 6- to 8-in. layer of fine sand was placed on the silty soil, and then the backfill was continued with pit-run gravel. This fine sand layer topped with coarser gravel is intended to function somewhat like an inverted blind drain to seal off any pumping action of the silt up through the gravel. The location of the groundwater table at a depth of about 6 ft below the old roadway surface in some of these sections aggravates the drainage problem.

A typical grading of the available sand used for backfilling is:

Passing No. 40 sieve	81 percent
Passing No. 100 sieve	47 percent
Passing No. 200 sieve	5+ percent

Subgrading was done on half the roadway width at a time to maintain traffic. A 1½-cu. yd dragline removed the silt and also the gravel surfacing layer, which was heavily infused with the silt, and wasted these materials adjacent to the roadway where possible, or loaded them into trucks for dumping off the roadway at locations which did not involve much overhaul.

A cross-section crew followed the excavating crew, and then the road was backfilled to the new grade with select borrow. Subgrade work on about three miles of the project called for about 58,000 cu yd of excavation and about 63,000 cu yd of select borrow for backfilling to the new grade.

On those sections of the roadway which did not break up during the spring thaw, but for which borings showed similar soil profiles, a minimum cover of 1 ft of select borrow was placed on top of the old roadway surface and particular attention was given to surface drainage.

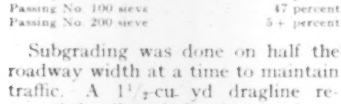

6 in. to 8 in. of Crushed Gravel Surfacing
1½ ft to 4 ft of Yellow and Gray Silt
Gravel Bed

FIG. 2. SOIL PROFILE under old roadway surface shows position of fine yellow and gray silt which caused damage to surfacing on sections of Glenn Highway, Alaska. Arrows represent pumping action which drew almost liquid silt up into gravel base course.

PERMAFROST CAUSES TROUBLE on Tok Cutoff about 30 miles northeast of Glenallen, Alaska. Old ditch was practically filled with slides from backslope caused by summer thawing of exposed permafrost, found here about 3 ft below natural ground surface. Ditch is seen being widened by Alaska Road Commission forces so that backslope will have a chance to stabilize at much flatter slope and still retain some ditch section. Bright areas in foreground are puddles of water from thawing ground which form as more permafrost is exposed. Part of excavation is cast across roadway onto shoulder slope on other side, and part is hauled away in trucks and dumped as waste.

Permafrost Causes Mud Flows

In the investigations that were made on Section B2 and B3 it was found that permafrost exists at a relatively shallow depth of 2 to 4 ft in places, with considerable organic cover. This condition prevailed also in some of the gravel pits, so that they could not be designated as borrow pits or as crushed aggregate pits for contract work. They were, however, used for maintenance purposes by utilizing the thawed out portion and thus exposing more frozen material to further thawing.

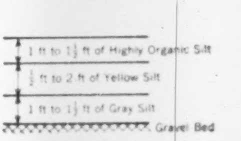

1 ft to 1½ ft of Highly Organic Silt
½ ft to 2 ft of Yellow Silt
1 ft to 1½ ft of Gray Silt
Gravel Bed

FIG. 3. SOIL PROFILE shows typical structure of natural ground adjacent to sections of Glenn Highway which broke up in 1949 spring thaw.

This process of exposing and thawing of the permafrost worked to considerable disadvantage on some of the roadway sections particularly on side-hill sections where fairly deep cuts had to be made to construct the original roadway. These cuts removed the insulating cover from the frozen ground beneath, and during the summer months further thawing took place and liberated enough water to cause mud flows down the backslope of the cuts and into the ditches. In some places, constant maintenance is required during the summer to keep the ditches cleaned out by blading the mud across the roadway over onto the shoulder slope.

Status at End of 1949 Working Season

Section B2, here described, is under the supervision of the Alaska Road Commission, with William J. Neimi, District Engineer at Anchorage, in charge. Some 20 miles of grading and base course were completed on this section last fall under contract with McLaughlin, Inc., of Great Falls, Mont., under the immediate supervision of Lawrence A. Paglia, Jun. ASCE, resident engineer at Palmer, Alaska. The writer spent the summer as Materials Engineer for the Alaska Road Commission on this section, and conducted soil and material surveys on Sections B2 and B3.

Grading, drainage, and crushed gravel base course for Section A, from Anchorage to Palmer, have been completed and there remains about 15 miles of asphalt mat to be laid next summer. The work was continued as late as possible in the fall until November 15. This project, under the supervision of the Public Roads Administration, has John E. Haapala as resident enginer.

It is expected that the entire length of the Glenn Highway will be completed by the fall of 1951.

HEAVY earthmoving equipment rolls embankment for northbound traffic lanes in reconstructing part of California's Ridge Route, which extends north for 44 miles from Los Angeles city limits to Kern County line. Existing three-lane highway, now carrying all traffic, will serve as two-lane roadway for southbound traffic upon completion of new pavement.

California Builds Wider, Safer Highway on Ridge Route

SPENCER V. CORTELYOU, M. ASCE

Assistant State Highway Engineer (Retired), Los Angeles, Calif.

RECONSTRUCTION and modernization of 23 miles of California's Ridge Route (a portion of U.S. 99) has now been completed, leaving only 21 miles for future construction. The new four-lane, limited-access, divided highway replaces three 10-ft lanes which had become inadequate for the large traffic volume carried. The high percentage of truck traffic probably hastened the obsolescence of the old highway, and the relatively high accident rate in recent years conclusively proved the need for a general widening throughout the length of the route.

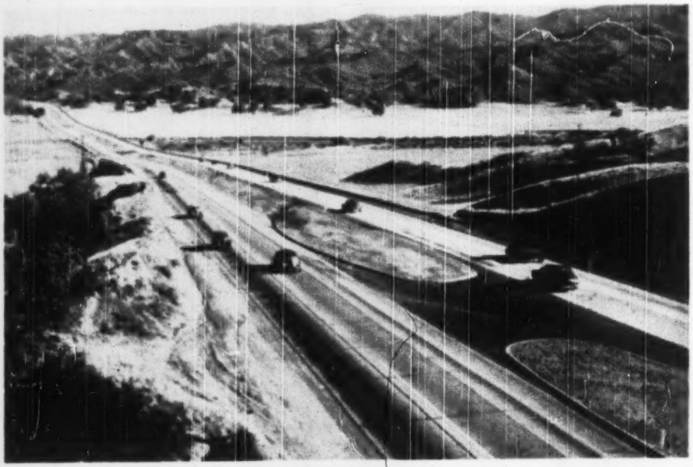
Studies for improvement of the Ridge Route, which extends for 44 miles northward from the Los Angeles city limits to the Kern County line, were started in 1940, but construction was delayed by the war. On November 18, 1943, the State Highway Commission approved reconstruction of portions of the route as a postwar project and design studies began for the general purpose of widening the existing right-of-way to provide a four-lane divided highway with the ingress and egress rights of abutting property owners limited.

Parts of Existing Pavement Utilized

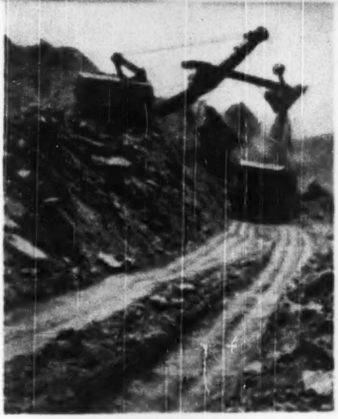
Pavement widening was accomplished in some cases by utilizing the existing 30-ft width of pavement for two lanes of traffic moving in one direction and adding a 24-ft width of new pavement to provide two traffic lanes for vehicles moving in the other direction. Where the existing pavement cannot be so utilized, two 24-ft widths of new pavement are provided. This separation of opposing traffic is of special importance on the Ridge Route because the lighter, faster traffic is continually pulling out of line and passing the more slowly moving trucks on long grades.

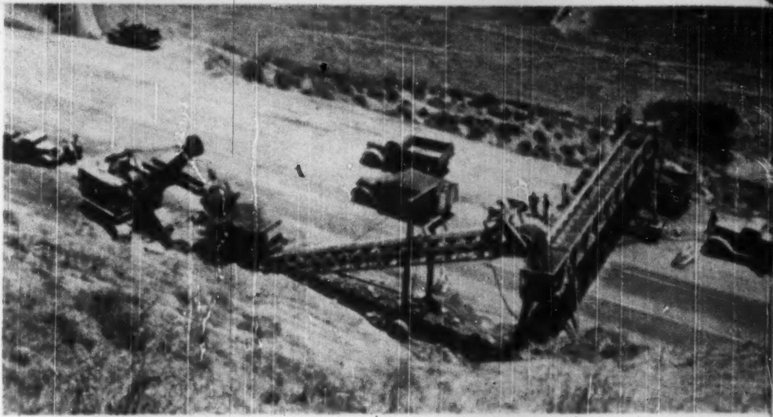
Through the mountainous portions of the Ridge Route, where grading costs are very great, the central division strip is 6 ft wide and contains raised bars outlined by double stripes. Where the grading costs do not limit the design, the central division strip has been made 42 ft wide. In the latter case, when advantageous, a drainage ditch is placed along the center of the division strip and paved shoulders 5 ft wide are placed adjacent to the main traveled lanes of the pavement. Along the outside edges of all pavement, paved shoulders 8 and 9 ft in width are provided so that ample space is available for parking of vehicles off the pavement.

Because of lack of stability in the geological formations at certain locations, extensive studies were made and designs worked out to prevent highway embankments from lateral movement by the construction of heavy buttress fills. An example of this type of design is the situation that existed at Violin Saddle about



WIDE MEDIAN STRIPS separate opposing lanes of traffic on reconstructed sections of California's Ridge Route where grading costs are not too high. Median strips are made narrower through mountainous country.





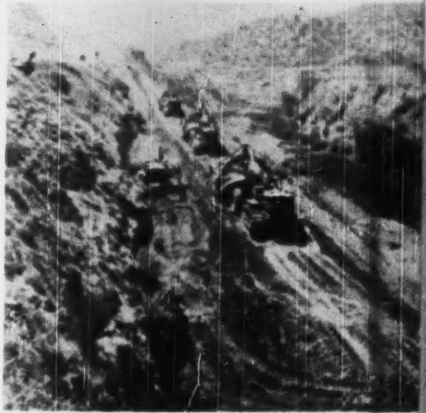
IN PLACES, movable conveyor-belt equipment (above) was installed by contractor over existing pavement to permit maintenance of normal traffic flow during grading operations to provide for widening of roadbed.

four miles north of Castaic. At this location a highway fill containing 300,000 cu yd exhibited a tendency to slide transversely, and a buttress fill containing about 200,000 cu yd was constructed to stabilize it. The fill extended out over the natural drainage channel, making it necessary to provide a paved overflow channel around the buttress area to supplement the existing inadequate culvert in the bottom of the canyon.

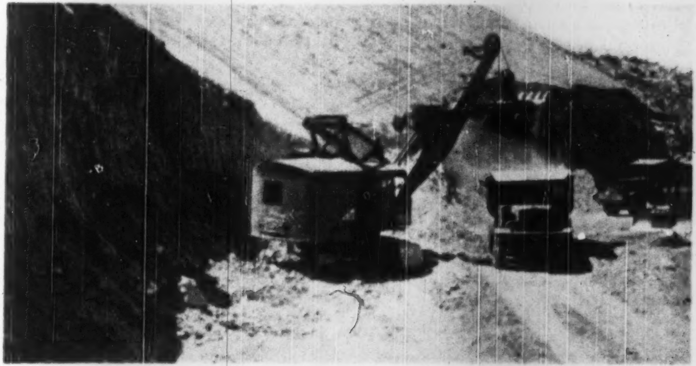
Geologic Studies Prove Valuable

Geological studies were made throughout the entire length of the Ridge Route project to assure that adequate measures were being taken to protect the highway from earth movements. Aerial photographs have been found very valuable in making geological studies of this nature. Studies for the improvement of alignment at Tejon Summit indicated that an apparently desirable alternate location existed through a valley north of the present road which would eliminate curvature and considerably shorten the line. Geological studies proved, however, that the San Andreas Fault runs through this valley—as shown on the accompanying aerial photograph by a line of small circles. This fault is one of the most active earthquake rifts in California, along which much lateral motion has taken place in recent years.

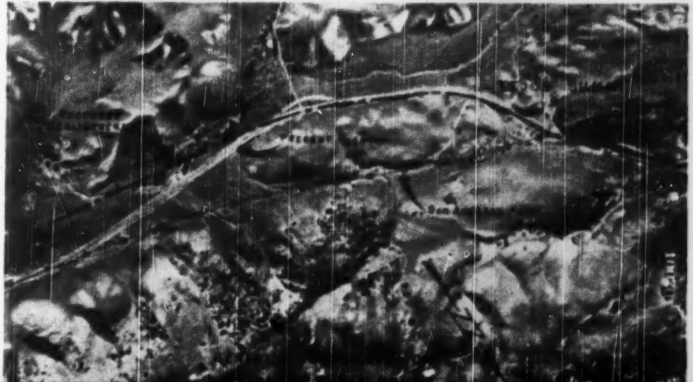
A recently published diary of one of the officers at Fort Tejon, situated a short distance west of Tejon Summit, describes an earthquake that occurred in the early 60's in which the displacement was so great that a horse corral fenced in the form of a 33-ft-dia circle was cut into two equal parts which slipped past each other so far that the two halves were en-



TYPICAL GRADING operations are carried out for Ridge Route widening and modernization. See view at right and that at top left.



STATE-OWNED borrow pits and quarries, such as that shown directly below, acquired before start of reconstruction on Ridge Route, save thousands of dollars in construction costs.



AERIAL PHOTOGRAPHS proved valuable in relocating Ridge Route. On photo (right), proposed realignment is indicated by dot-dash line. Row of circles indicates line of San Andreas Fault, one of California's most active earthquake rifts.

CHANNELIZATION of intersection with State Highway 77 further reduces traffic hazard along Ridge Route.

tirely separated. At the time of the San Francisco earthquake in 1906, the longitudinal displacement along the San Andreas Fault was found to reach a maximum of 20 ft in many locations, and the transverse displacement measured several feet.

Since the San Andreas Fault is to be avoided in highway location as well as in other construction whenever possible, this valley was disqualified as an alternate location for the highway. The alignment adopted for this part of the Ridge Route is indicated on the aerial photograph by the black dashed line.

Many High Cuts

Because of the rough, mountainous terrain encountered at many locations, excavation slopes sometimes extend vertically upward more than 200 ft over the roadway. In such cases, the cut slopes are designed only after a study of the geological formation. At many critical locations benches are excavated at higher levels in the face of the cuts to relieve the overburden weight and prevent future slides.

Several important channel changes had to be made to control the flow of drainage water. Existing drainage structures were extended and additional drainage provided where necessary. As a protection against capillary absorption of moisture from the original ground by the newly placed fill material, pervious blankets of river-bed sand and gravel are being laid as a base for all the new fills where required.

As the designs progressed, it became evident that large quantities of selected porous material would be needed for the lower portions of roadway embankments to provide adequate drainage. Suitable material could not be found on the highway right-of-way, but prospecting investigations carried out by the District materials staff, located an area in Castaic Creek about a half mile from the highway, where an adequate supply of pervious material was available.

Borrow agreements were negotiated with property owners by the District Right-of-Way Department on the basis of obtaining a maximum quantity of 90,000 cu yd. The borrow privilege extends for a period of three years from the date of the agreement. It is expected that a sufficient quantity of material will be available at this site to provide all of this type of imported borrow needed on the Ridge Route.

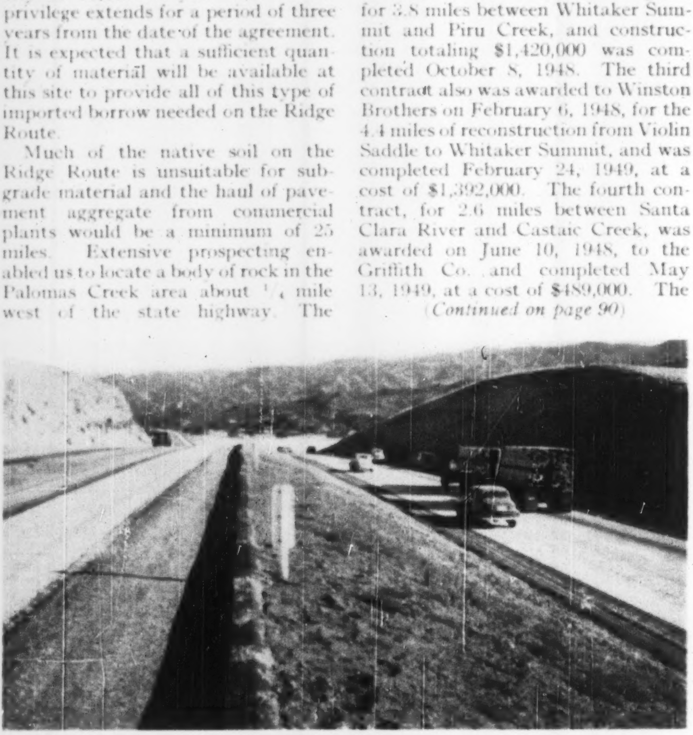
Much of the native soil on the Ridge Route is unsuitable for subgrade material and the haul of pavement aggregate from commercial plants would be a minimum of 25 miles. Extensive prospecting enabled us to locate a body of rock in the Palomas Creek area about 1/4 mile west of the state highway. The land was purchased and leased, and a large quantity of high-quality breccia is now available for use in subgrade and pavement. To date 325,000 tons have been hauled from this state-owned quarry.

To keep hauling costs to a minimum, considerable distances on both sides of the Ridge Route have been prospected to find the most suitable sources of material for subgrade and pavement, and quarrying rights have been obtained at several locations. The lining up in advance of sources of satisfactory material for road construction in close proximity to the highway has already resulted in savings to the state of hundreds of thousands of dollars in construction costs.

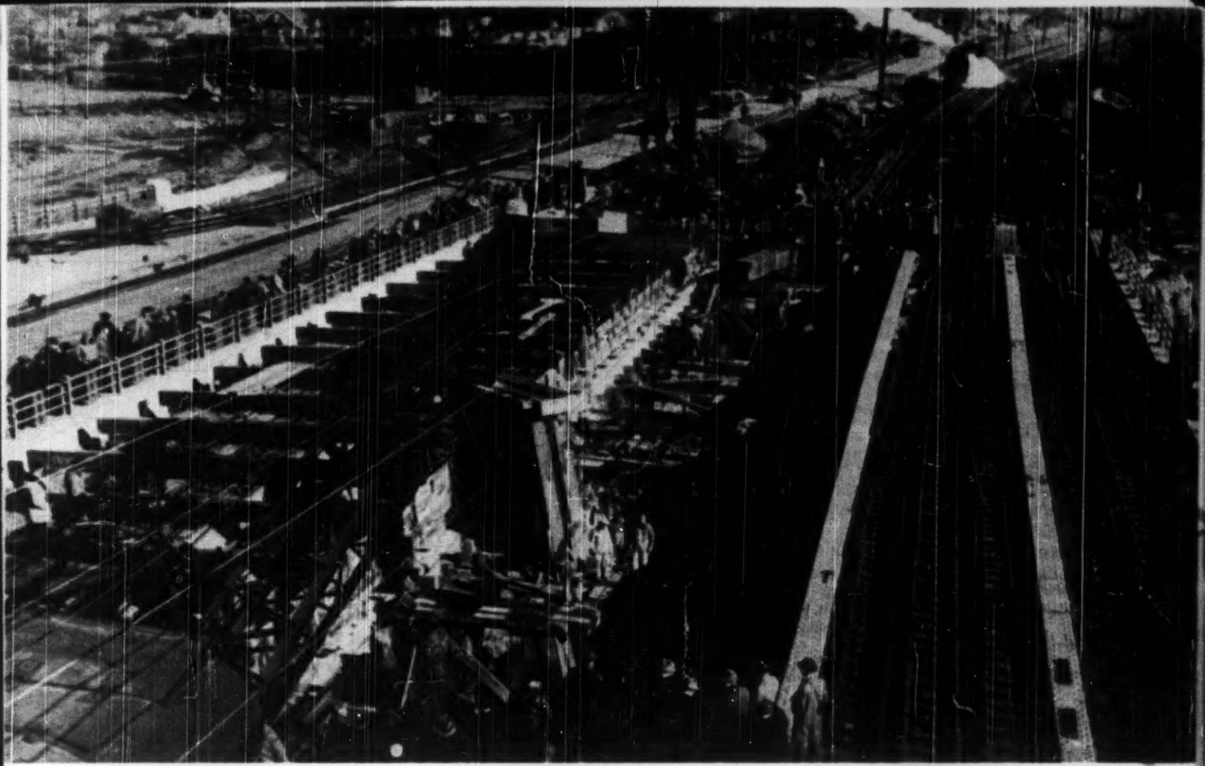
Six Contracts Executed to Date

Reconstruction contracts on the Ridge Route completed by the end of 1949, total $5,500,000. The first reconstruction contract was awarded on March 10, 1947, to the Clyde Wood Construction Co. of Los Angeles, for 2.6 miles between Palomas Creek and Violin Saddle, and this work, totaling $795,000, was completed June 9, 1948. The second contract was awarded May 29, 1947, to Winston Brothers of Los Angeles, for 3.8 miles between Whitaker Summit and Piru Creek, and construction totaling $1,420,000 was completed October 8, 1948. The third contract also was awarded to Winston Brothers on February 6, 1948, for the 4.4 miles of reconstruction from Violin Saddle to Whitaker Summit, and was completed February 24, 1949, at a cost of $1,392,000. The fourth contract, for 2.6 miles between Santa Clara River and Castaic Creek, was awarded on June 10, 1948, to the Griffith Co. and completed May 13, 1949, at a cost of $489,000. The

(*Continued on page 90*)



BARRIER POSTS mark median strip along section of Ridge Route between Santa Clara River and Pico Canyon. Paved shoulders 8 or 9 ft in width provide ample parking space for disabled vehicles.



LOCOMOTIVE CRANES dismantle temporary track stringers and trestle bents prior to rolling in of completed north half of bridge, here seen directly at left. Further to left, spectators watch operations from behind rail of Lincoln Highway Bridge. South half of railroad bridge, at right, has already been rolled into place.

1,400-Ton Railroad Bridge Is Pulled Into Position in 30 Minutes

MORRIS GOODKIND, DIRECTOR ASCE

Bridge Engineer, New Jersey Highway Department,
Trenton, N.J.

AS PART of the first parkway to be constructed in New Jersey, designated Route 4 Parkway, which will ultimately extend from Clifton to Cape May, it was necessary to cross Route 27 (Lincoln Highway) and the main line of the Pennsylvania Railroad at Iselin. The Parkway underpasses both crossings, which are 91 ft apart on centers with a common right-of-way line. The operations incident to the erection of the railroad bridge are worthy of special note.

The Pennsylvania Railroad operates four high-speed main-line tracks in this area. Because of the extensive nature of train movements on these tracks between the West and South and New York, no changes in operating schedules or reduction in speed were contemplated, nor could any temporary track relocation be considered. Except for two construction phases, all work had to be done without interrupting the use of the four tracks.

Design of Permanent Railroad Bridge

The railroad bridge consists of two spans having a total length of 167 ft, supported on two abutments and a middle pier. The superstructure consists of five half-through plate girders, 14 ft on centers and connected with rolled-section floor beams, supporting the concrete deck slab, ballast and tracks. The superstructure was built on rolling-in bents in two complete halves, each consisting of two spans and providing for two tracks. One half was erected north of the permanent location, in the limited area between the railroad and the highway bridge, and the second half south of its final position. The mid-girder of the five was first used for the assembly of the north half, with bolted connections, and then was reused in the south half, where it was finally riveted. Before its removal from the north section, temporary timber needle beams were clamped across the top flanges of the other two girders, from which hanger rods were connected to the free ends of the floor beams to pick up the unsupported load.

In all operations comprising erection of the temporary trestle and construction of the concrete abutments and pier, the only work performed from track level was the installation of the temporary track stringers. Each rail was supported by a preassembled group of 16-in. WF 71-lb, or 33-in. WF 130-lb. beams, depending on the span length. One track at a time was taken out of service to permit excavation for, and placing of, the temporary sills and track blockings, mud sills and steel stringers. Track 1 was out of service on January 11, 12 and 14 from 11 a.m. to 4:40 p.m.; Track 2, January 18 and 19 from 9 a.m. to 6:30 p.m.; Track 3, January 25 and 26 from 4 a.m. to

ROLLING-IN OPERATION was preceded by ten months of intensive preparation. As first step (left), built up I-beam track girders are set on sills. Second (center), dragline scraper excavates trenches for longer temporary bents which replace sills. Third (right), wedges are tightened under track-supporting bents in readiness for final excavation.

2:20 p.m., and Track 4, February 1, 2 and 3, from 8:30 a.m. to 2:30 p.m. All other work was done from below the track level.

Temporary Timber Bents Support Tracks

Bents of the temporary trestle were made up of timber sills, posts and caps, and were constructed in eight successive stages until they reached the ultimate depths and locations necessary to permit construction of the permanent bridge substructure. The process of excavation employed during this phase of the job can only be described as one of tedious and persistent burrowing.

Hand shovels and picks were resorted to until sufficient clearance was obtained for the use of an ingenious device which the contractor installed for excavation within the limited working space. This device consisted of a $^3/_4$-cu yd open-bottom scraper operated by a winch located beyond the track area through a continuous cable reeved through a sheave on the opposite side. In this manner trenches of increasing depth were dug as intermediate bents were installed, and the load was transferred alternately until final elevations were reached. The temporary trestle required 19,000 cu yd of excavation, 200 tons of structural steel, and 800 million fbm of timber.

On completion of abutments and piers, rolling-in bents were constructed, four on each side of the permanent bridge location. The bents were continued through the bridge width, where they were supported on the footings of the abutments and pier. These bents consisted of double timber frames, with 8 × 10-in. ties placed across their caps to support four lines of 100-lb rails. Roller nests, made up of $2^1/_2$-in.-dia cold rolled steel, 3 ft long on 12-in. centers and fitted into continuous side plates, were mounted on the lower rails. Above the rollers another group of four 100-lb rails was placed head down, to which was added the blocking necessary to support the several girders of each section.

The permanent superstructures were constructed on the rolling-in bents. The south half, which included three main girders, was erected complete with concrete deck and haunches, ballast and tracks, and weighed 1,400 tons. The north half, from which the mid-girder had previously been removed, was erected complete except for that part of the concrete deck which had to be omitted temporarily to permit connections to be made to the south half.

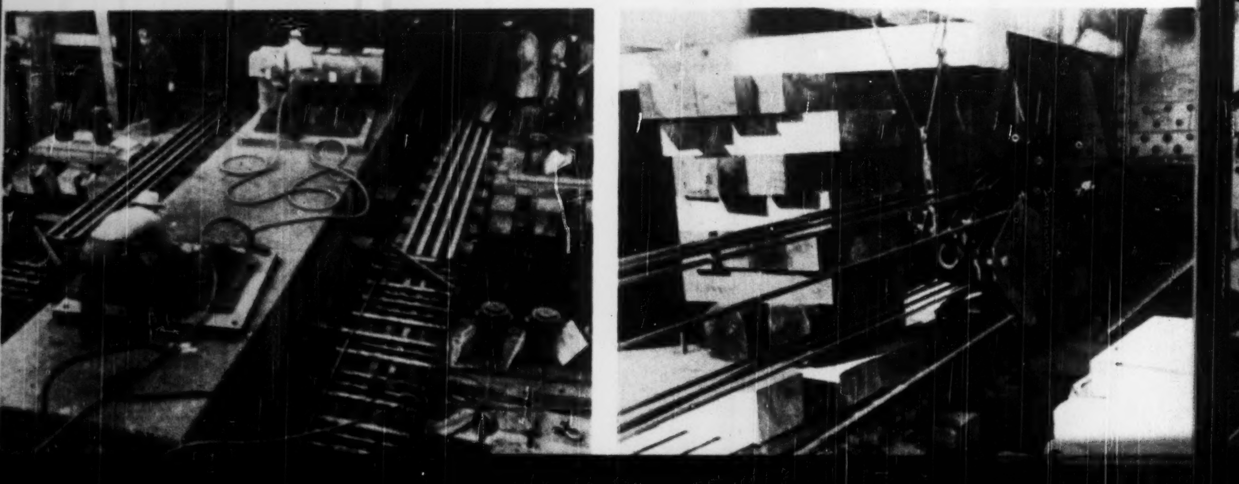
Four jacking bents of double timber frames were erected within the width of the permanent bridge site, one at each abutment and one each side of the pier and just forward of the rolling-in bents. These jacking bents were used for raising the bridge sections off the rolling-in bents and lowering them to the permanent bridge seats. On each of the jacking bents were set seven 100-ton hydraulic jacks, two at each exterior girder location and three at the interior girder. Jacks were hooked up in pairs to pumps, with an additional pump for the third jack at the interior girder.

Two Sections of Bridge Are Rolled In

After about ten months of preliminary construction and preparation, the dates for rolling the permanent bridge into its final position were set. The south half, composed of three main girders with provision for the two eastbound tracks, was to be moved in on Sunday, November 20, 1949, and the north section, for the two westbound tracks, on Sunday, December 4, at hours during which train movements were the lightest.

At 4:30 a.m. on November 20, all railroad traffic was switched to the westbound tracks and the operation of dismantling the temporary trestle for the two eastbound tracks was begun. Two 60-ton locomotive cranes, one at each end of the crossing and operating from the outer track, first removed the inner track trestle

RAILS AND STEEL ROLLERS (left view, below) are ready for rolling new bridge into place on permanent pier. Bridge has been erected on near end of rollers alongside of and parallel to final position. Pulling lines, attached at both ends of each span, haul completed bridge—with concrete deck, ties, rails and ballast in place—into alignment so that jacks can seat bridge on its shoes. Right view shows tackle attached to under side of girder in readiness for pulling bridge into final position.



working from the ends to the middle, and then removed the outer track trestle from the middle toward the ends. The area was cleared by 2 p.m.

Power for moving the bridge was supplied by four two-drum gasoline hoists stationed south of the bridge and in line with each of the rolling-in bents. The hoists were tied back to concrete deadmen. The pulling tackle was anchored to the interior girder of the north half of the permanent bridge. After the roller assemblies were thoroughly cleaned and greased, as well as the pins and bearings of the bridge shoes, and final adjustments made to the tensions in the four sets of tackle, the final bridge movement was begun at 3:15 p.m. Rolling progressed in intermittent stages to permit checking and adjustment in alignment. The entire movement took thirty minutes, so that at 3:45 p.m. track crews went to work lining up rails and splicing and tamping ballast while jacking crews working below raised the bridge, removed blocking, and seated it on the shoes. Four-track service was restored by 5:15 p.m.

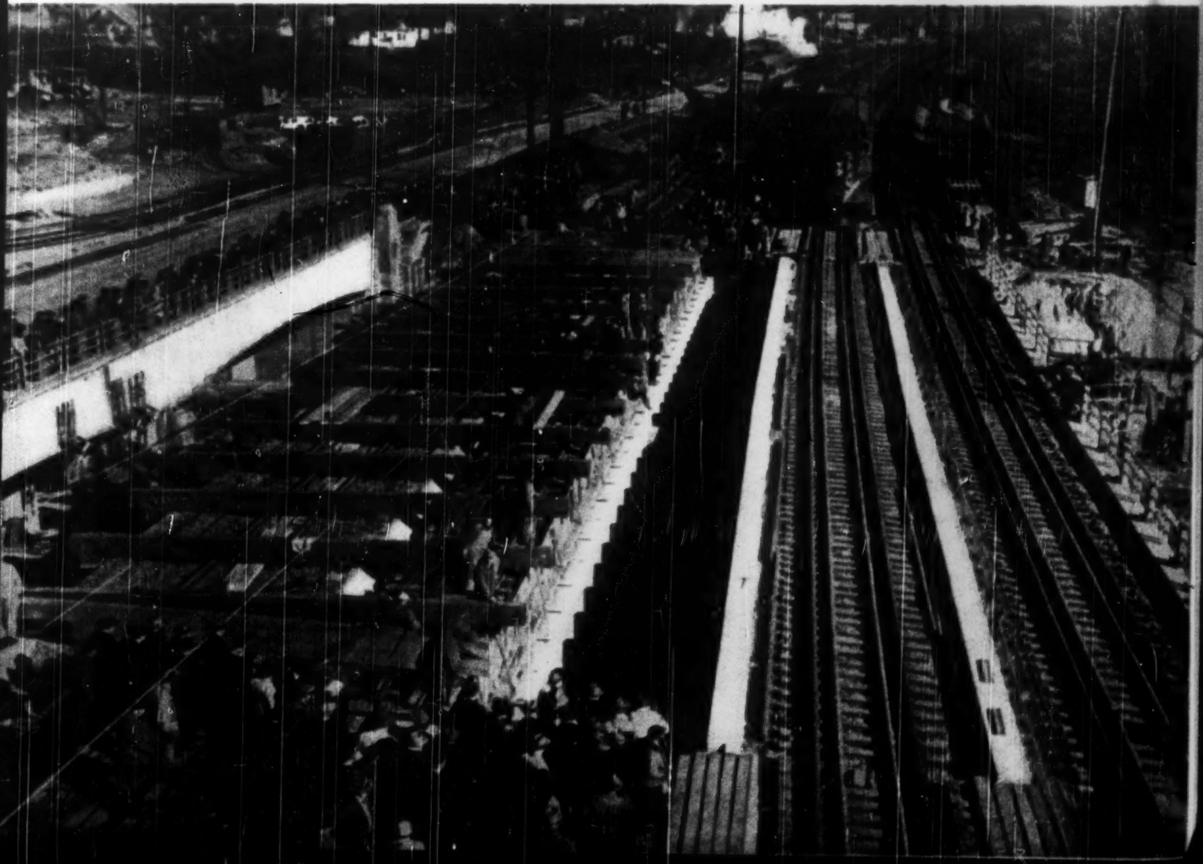
The north half consisted of only two main girders. The outer ends of the floorbeams for the inside track were supported by hangers from the overhead needle beams. Although ties and rails were already installed, ballast was kept at a minimum to reduce the weight of the overhang. Allowance was made for the additional time required to make the connection between the first and second sections and for completing the ballasting. Start of operations on the north section was advanced to 3 a.m., December 4.

In general the procedure followed that of the first move except for the change in rigging due to the direction of movement. Until this half was finally pulled home, concern was felt as to the fit of the 37 floorbeam connections to the first section. However, the accuracy with which these holes matched left nothing to be desired. The bridge was in its final position at 2 p.m., when temporary connections were made using bolts and drift pins. The first train passed over the outer track at 3:20 p.m. and the inner track, which was opened later because of the necessary ballasting operations, was cleared at 6 p.m.

Both the railroad and highway bridges at this crossing are being built by Brann & Stuart of Philadelphia under contract with the State Highway Department of New Jersey. The project is being financed by the State and the U. S. Bureau of Public Roads. The design of the railroad bridge was prepared by The Pennsylvania Railroad in cooperation with the State Highway Department.

For the contractor, R. D. McGilvra, Assoc. M. ASCE, is superintendent and engineer. For the Pennsylvania Railroad, J. J. Clutz is Assistant Chief Engineer. For New Jersey, Spencer Miller, Jr., is State Highway Commissioner, E. W. Kilpatrick, Acting State Highway Engineer, Morris Goodkind, M. ASCE, Bridge Engineer, and A. H. Stetser, Resident Engineer.

NORTH HALF OF BRIDGE rolls into position in 30 minutes on Sunday, December 4, when train movement is light. Hangers from timber needle beams over deck temporarily support outer ends of floor beams until they engage inside girder of south bridge half, which is already in place



Engineers' Notebook

Simple Diagram Gives Direct Solution for Stresses in Reinforced Concrete Members

ERIK SOLLID

Engineer, Bureau of Reclamation, Denver, Colo

A DESIGN METHOD has been developed which will solve directly for the stresses in any reinforced concrete member subjected to bending with or without direct tension or compression. The method is limited by the following assumptions: (1) The member is rectangular, or better, the section area in compression is rectangular; and (2) reduction of compressive concrete area due to compressive reinforcement is disregarded. Other assumptions are those standard to the theory of reinforced concrete design. The method was originally described in the Bureau of Reclamation Technical Memorandum No. 629, by L. W. Crandall, Assoc. M. ASCE, George Evans, Jun. ASCE, Erik Sollid, H. L. Neve, M. ASCE, and Samuel Judd. In this paper, the method has been shortened and revised to eliminate trial and error procedures.

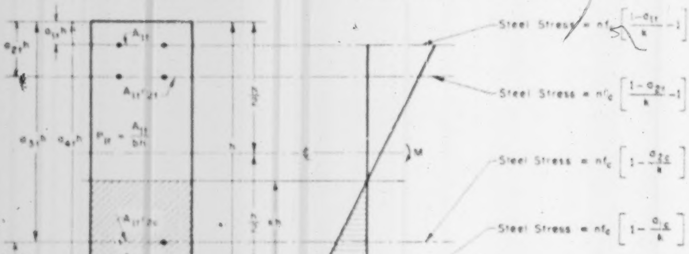
Derivation of Equations

From the conditions of equilibrium,

$$\Sigma M = 0, \quad \Sigma N = 0$$

and by inspection of Fig. 1, two equations for N, direct stress, are obtained.

FIG. 1. **Diagram indicates assumptions for general equations for direct stress in rectangular reinforced concrete beam**


$a_{1t}h$
$a_{2t}h$
A_{1t}
$A_{1t}r_{2t}$
$a_{3t}h$
$a_{4t}h$
$p_{1t} = \frac{A_{1t}}{bh}$
$A_{1t}r_{2c}$
$A_{1t}r_{1c}$
$a_{2c}h$
$a_{1c}h$
b
h
$\frac{h}{2}$
$\frac{h}{2}$
kh
℄
M
f_c
Steel Stress = $nf_c\left[\frac{1-a_{1t}}{k}-1\right]$
Steel Stress = $nf_c\left[\frac{1-a_{2t}}{k}-1\right]$
Steel Stress = $nf_c\left[1-\frac{a_{2c}}{k}\right]$
Steel Stress = $nf_c\left[1-\frac{a_{1c}}{k}\right]$
Concrete Stress = $f_c = C\frac{M}{bh^2}$

NOTATION

A = a section constant
B = a section constant
b = width of section in compression
b_1, b_2, b_3 = constants of cubic equation for C
$C = (f_c bh^2)/M$
e = eccentricity required for N to produce the moment as indicated in Fig. 1
f_c = maximum unit concrete stress
E_c = Young's modulus of elasticity of concrete in compression
E_s = Young's, modulus of elasticity of steel
h = total depth of section
k = fraction of h in compression
M = bending moment about a point half way between faces of section
N = direct tensile or compressive force
$n = E_c/E_s$
n_1, n_2, n_3 = constants of cubic equation for k
p = steel ratio for first row of tensile steel = A_{1t}/bh
$r_{1t}, r_{2t}, r_{1c}, r_{2c}$, etc. = ratio of steel in respective rows to that in first row of tensile steel; therefore $r_{1t} = 1$
x = value of cubic equation for approximate value of k
$\Delta = x/(2n_1k + n_2)$ = correction to be added or subtracted from k when value of cubic equation is x

NOTE: Other notations are defined where they first appear.

For bending and direct tension,

$$N = f_c bh\frac{h}{e}\left\{\frac{np}{k}\left[(1 - a_{1t} - k)(^1/_2 - a_{1t})r_{1t} + (1 - a_{2t} - k)(^1/_2 - a_{2t})r_{2t} + (k - a_{1c})(^1/_2 - a_{1c})r_{1c} + (k - a_{2c})(^1/_2 - a_{2c})r_{2c}\right] + \frac{k}{2}\left(^1/_2 - \frac{k}{3}\right)\right\} \quad (1)$$

and

$$N = f_c bh\left\{\frac{np}{k}\left[(1 - a_{1t} - k)r_{1t} + (1 - a_{2t} - k)r_{2t} - (k - a_{1c})r_{1c} - (k - a_{2c})r_{2c}\right] - \frac{k}{2}\right\} \quad (2)$$

For bending and direct compression,

$$N = f_c bh\frac{h}{e}\left\{\frac{np}{k}\left[(1 - a_{1t} - k)(^1/_2 - a_{1t})r_{1t} + (1 - a_{2t} - k)(^1/_2 - a_{2t})r_{2t} + (k - a_{1c})(^1/_2 - a_{1c})r_{1c} + (k - a_{2c})(^1/_2 - a_{2c})r_{2c}\right] + \frac{k}{2}\left(^1/_2 - \frac{k}{3}\right)\right\} \quad (3)$$

and

$$N = f_c bh\left\{\frac{k}{2} - \frac{np}{k}\left[(1 - a_{1t} - k)r_{1t} + (1 - a_{2t} - k)r_{2t} - (k - a_{1c})r_{1c} - (k - a_{2c})r_{2c}\right]\right\} \quad (4)$$

Equating the two expressions for N in each case and solving for k gives cubic equations that for both direct tension and compression may be written,

$$k^3 + n_1k^2 + n_2k + n_3 = 0 \quad (5)$$

The constants n_1, n_2, and n_3, as shown later, are easily computed for a given case, and then k is obtained from Fig. 2. For a given beam section it is convenient first to compute two constants, A and B, that properly may be called section constants. The expressions for A and B, obtained when solving for k from Eqs. 1 to 4, are given below in Eqs. 6 and 7, and later simplified.

$$A = 6np[(^1/_2 - a_{1t})r_{1t} + (^1/_2 - a_{2t})r_{2t} - (^1/_2 - a_{1c})r_{1c} - (^1/_2 - a_{2c})r_{2c}] \quad (6)$$

$$B = 6np[(1 - a_{1t})(^1/_2 - a_{1t})r_{1t} + (1 - a_{2t})(^1/_2 - a_{2t})r_{2t} - r_{1c}(^1/_2 - a_{1c})a_{1c} - r_{2c}(^1/_2 - a_{2c})a_{2c}] \quad (7)$$

By using the notations shown in Fig. 1, the depth, as a fraction of h, to the compressive steel a_{1c} and a_{2c}

may be written $(1 - a_{4t})$ and $(1 - a_{3t})$, respectively. Substituting this in Eqs. 6 and 7, and letting

$D = r_1 + r_2 + \ldots$ (summation of r ratios for each row of steel)

$E = a_1r_1 + a_2r_2 + \ldots$ (summation of ar values for each row of steel), with t dropped from the subscript

$F = a_1^2r_1 + a_2^2r_2 + \ldots$ (summation of a^2r values for each row of steel)

The equations are simplified to

$$A = 6np(^1/_2D - E) \quad \ldots \quad (8)$$

$$B = 6np(^1/_2D - 1.5E + F) \quad \ldots \quad (9)$$

These are extremely simple equations obtained by adding up r ratios, products of ar and a^2r for each row of steel, and then multiplying by $6np$.

Using the substitutions for a_{1c}, a_{2c}, etc., resorted to above, the constants of Eq. 5 are:

For bending and direct tension:

$$n_1 = -3(^1/_2 + e/h) \quad \ldots \quad (10)$$

$$n_2 = -6np\frac{e}{h}D + A \quad \ldots \quad (11)$$

$$n_3 = +6np\frac{e}{h}(D - E) - B \quad \ldots \quad (12)$$

For bending and direct compression:

$$n_1 = +3(e/h - {}^1/_2) \quad \ldots \quad (13)$$

$$n_2 = +6np\frac{e}{h}D + A \quad \ldots \quad (14)$$

$$n_3 = -6np\frac{e}{h}(D - E) - B \quad \ldots \quad (15)$$

The arithmetical work of deriving the above constants is not shown but is a direct result of equating the two expressions for N in Eqs. 1–4.

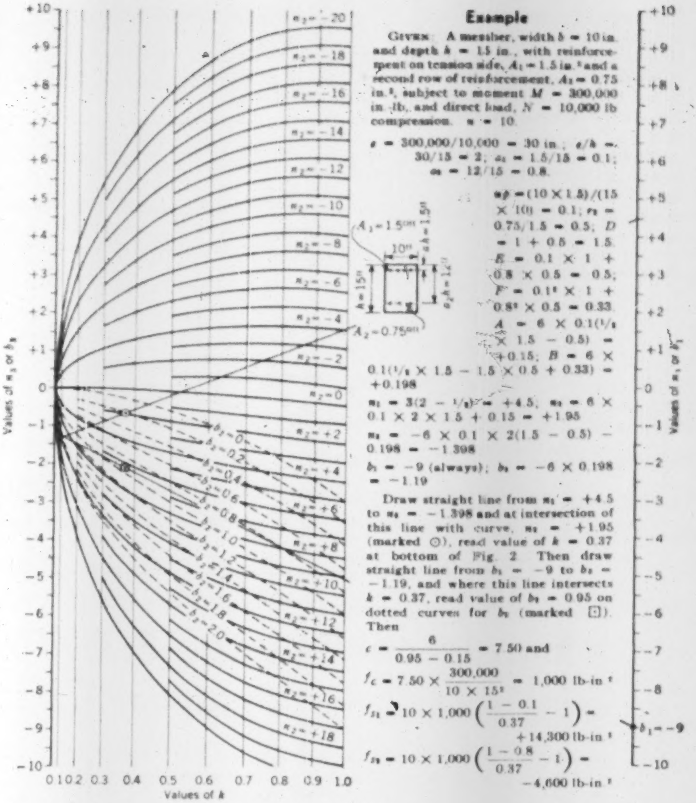
As bending alone is approached, e/h increases without limit. It is seen that as e/h becomes very large, the effect of the additive quantities, not factors of e/h in Eqs. 10, 11, and 12, is insignificant, and may be dropped. The constants then may be written:

$$n_1 = -3e/h \quad \ldots \quad (16)$$

$$n_2 = -6np\frac{e}{h}D \quad \ldots \quad (17)$$

$$n_3 = +6np\frac{e}{h}(D - E) \quad \ldots \quad (18)$$

Since the constants increase without limit, as e/h increases without limit, it would seem that Fig. 2 could not be used for bending alone. However, with some inaccuracy, the scales for n_1 and n_3, as they appear in Fig. 2, may be considered to run from 0 to ±100, ±1,000, or any higher number. (The scale of n_2 must be changed correspondingly.) In Eqs. 16, 17, and 18, e/h is therefore merely a scale factor and may be set equal to 1.



Example

GIVEN: A member, width $b = 10$ in. and depth $h = 15$ in., with reinforcement on tension side, $A_1 = 1.5$ in.² and a second row of reinforcement, $A_2 = 0.75$ in.², subject to moment $M = 300{,}000$ in.-lb, and direct load, $N = 10{,}000$ lb compression. $n = 10$.

$e = 300{,}000/10{,}000 = 30$ in.; $e/h = 30/15 = 2$; $a_1 = 1.5/15 = 0.1$; $a_2 = 12/15 = 0.8$.

$np = (10 \times 1.5)/(15 \times 10) = 0.1$; $r_2 = 0.75/1.5 = 0.5$; $D = 1 + 0.5 = 1.5$. $E = 0.1 \times 1 + 0.8 \times 0.5 = 0.5$; $F = 0.1^2 \times 1 + 0.8^2 \times 0.5 = 0.33$. $A = 6 \times 0.1(^1/_2 \times 1.5 - 0.5) = +0.15$; $B = 6 \times 0.1(^1/_2 \times 1.5 - 1.5 \times 0.5 + 0.33) = +0.198$

$n_1 = 3(2 - {}^1/_2) = +4.5$; $n_2 = 6 \times 0.1 \times 2 \times 1.5 + 0.15 = +1.95$

$n_3 = -6 \times 0.1 \times 2(1.5 - 0.5) - 0.198 = -1.398$

$b_1 = -9$ (always); $b_3 = -6 \times 0.198 = -1.19$

Draw straight line from $n_1 = +4.5$ to $n_3 = -1.398$ and at intersection of this line with curve, $n_2 = +1.95$ (marked ⊙), read value of $k = 0.37$ at bottom of Fig. 2. Then draw straight line from $b_1 = -9$ to $b_3 = -1.19$, and where this line intersects $k = 0.37$, read value of $b_2 = 0.95$ on dotted curves for b_2 (marked ⊡). Then

$$c = \frac{6}{0.95 - 0.15} = 7.50 \text{ and}$$

$$f_c = 7.50 \times \frac{300{,}000}{10 \times 15^2} = 1{,}000 \text{ lb-in.}^2$$

$$f_{s1} = 10 \times 1{,}000\left(\frac{1 - 0.1}{0.37} - 1\right) = +14{,}300 \text{ lb-in.}^2$$

$$f_{s2} = 10 \times 1{,}000\left(\frac{1 - 0.8}{0.37} - 1\right) = -4{,}600 \text{ lb-in.}^2$$

FIG. 2 Diagram gives coefficients for direct solution of any rectangular, doubly reinforced concrete beam. Example demonstrates use of diagram. On request to the writer, this diagram is available in more detail and to larger scale, with self-explanatory equations.

The constants for bending alone then are:

$$n_1 = -3 \quad \ldots \quad (19)$$

$$n_2 = -6np\,D \quad \ldots \quad (20)$$

$$n_3 = +6np(D - E) \quad \ldots \quad (21)$$

The end number of the scale for n_1 and n_3, used in constructing Fig. 2, is 10. If a higher number had been chosen, the diagram would have been more nearly symmetrical, but more difficult to read. The higher the end number of the scale, the closer the diagram would be to symmetry. The constants for bending alone are therefore based on a symmetrical diagram. Had Eqs. 13, 14, and 15 been used in deriving the constants for bending alone, they would have appeared with opposite signs. This fact may be taken advantage of by first obtaining k, using the signs as shown in Eqs. 19, 20, and 21, then repeating, using opposite signs. The average of the two k values thus obtained is correct, subject, of course, to the accuracy of the diagram.

The effect of this procedure is to counteract the effect of non-symmetry of the diagram. As e/h increases, conditions of bending alone are approached rapidly. For values of e/h larger than 10, k changes very little. In most design problems, the value of the constants n_1 and n_3 will lie between 0 and 10. Whenever any of the values exceed 10, consider the side scale to run from 0 to 100, and change the scale of n_2 by the same ratio. The inaccuracy in k will be small.

At first glance, Fig. 2 may appear complicated, but on closer examination it is seen to be extremely simple. Starting from the tensile side of a section, the constants are chiefly summations of r, ar, and a^2r, one term for each row of steel, without regard to the location of the neutral axis. This is true no matter how many rows of steel there are. Consequently, this method gives a direct solution for k, hence the stresses. In tabular form, the computations are further simplified.

Having found k from Fig. 2, the concrete stresses may be found quickly by using the same diagram, as shown by the following derivation:

Rewriting Eq. 1,

$$M = Ne = f_c bh^2 \left\{ \frac{np}{k}\left[(1 - a_{1t} - k)(1/2 - a_{1t})r_{1t} + (1 - a_{2t} - k)(1/2 - a_{2t})r_{2t} + (k - a_{1c})(1/2 - a_{1c})r_{1c} + (k - a_{2c})(1/2 - a_{2c})r_{2c}\right] + \frac{k}{2}\left(1/2 - \frac{k}{3}\right)\right\} \quad (22)$$

The bracketed quantity in Eq. 22 is equal to the reciprocal of C as defined in the notation. Therefore

$$\frac{1}{C} = \frac{np}{k}\left[(1 - a_{1t} - k)(1/2 - a_{1t})r_{1t} + \qquad\right] \quad (23)$$

Simplifying Eq. 23 gives

$$k^3 - 1.5k^2 + \left(\frac{6}{C} + A\right)k - B = 0 \quad (24)$$

In general, Eq. 24 may be written as follows:

$$k^3 + b_1k^2 + b_2k + b_3 = 0 \quad (25)$$

Since k already has been found, the only unknown quantity in Eq. 25 is b_2, and b_2 may be obtained from Fig. 2. For greater accuracy in reading the diagram, the constants of Eq. 25 have been multiplied by 6 so that:

$$b_1 = -1.5 \times 6 = -9 \text{ (always)} \quad (26)$$

$$b_3 = -B \times 6 = -6B \quad (27)$$

Multiplying b_2 by 6 is accomplished by changing the scale in the diagram so that b_2 is read from the dotted curves, or b_2 may be computed from

$$b_2 = B/k + 1.5k - k^2 \quad (28)$$

Having found b_2,

$$C = 6/(b_2 - A) \quad (29)$$

The concrete and steel stresses are then obtained from the equations shown in Fig. 1.

If greater accuracy is wanted than is obtainable from Fig. 2, apply a correction derived as follows:

For a given case, compute n_1, n_2, and n_3; then read k from the diagram and insert in Eq. 5. Since k as read from the diagram is necessarily approximate, Eq. 5 will not equal zero, but some value, x. Therefore

$$k^3 + n_1k^2 + n_2k + n_3 = x \quad (30)$$

Now correct this value of k by an amount, Δ, such that

$$(\Delta + k)^3 + (\Delta + k)^2 n_1 + n_2(\Delta + k) + n_3 = 0 \quad (31)$$

Expand Eq. 31; subtract Eq. 30 from it. Disregarding squares and higher powers, and solving for Δ gives

$$\Delta = x/(2n_1k + n_2) \text{ (approximately)} \quad (32)$$

It is easily seen from the signs of the constants in each case whether Δ must be added to or subtracted from k.

Experimental Pneumatic Roller Promises Reduced Compaction Costs

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Respectively Division Soil Engineer and District Soil Engineer,
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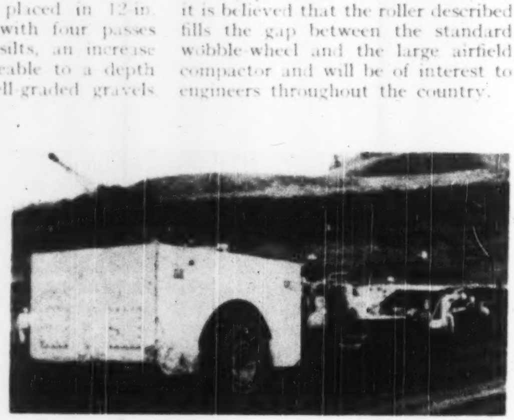
MATERIAL CHARACTERISTICS largely determine the best means of obtaining soil compaction. In the Willamette Valley, Oregon, many predominantly clay soils contain sufficient gravel or talus rock to interfere with compaction by standard sheepsfoot rollers. With standard wobble-wheel pneumatic rollers, fill must be placed in thin layers.

As an experiment in determining the size and type of roller most suitable for general construction work in this area, the Portland District, Corps of Engineers, recently purchased, under contract specifications, the pneumatic roller shown in the accompanying photograph. This roller, manufactured by the William Bros. Boiler and Manufacturing Co., Minneapolis, Minn., has four 18 × 24-in. tires mounted on two axles which are free to oscillate longitudinally. The 450-cu ft body, when filled with sand and gravel, weighs from 20,000 to 80,000 lb. Higher total weights can be obtained using heavier ballast. A D-8 tractor handles the loaded roller with ease and can make a 180-deg turn, without backing, on a fill 25 ft wide.

Good Compaction of Thick Layers Obtained

Experience to date, which has been limited to a total roller weight of 70,000 lb, indicates that good compaction is obtained in silt and cohesive soils when placed in 12-in. layers and rolled with four passes of the roller. In silts, an increase in density is noticeable to a depth of 3 ft. Clean well-graded gravels with 12-in. maximum size were compacted effectively when placed in 18-in. layers and rolled with two passes.

It is evident that the use of a pneumatic roller similar to the experimental roller for compaction of soils such as those found in the Willamette Valley, will permit thicker layers and fewer passes and should result in lowering the cost of embankment construction. While compaction by pneumatic rollers is not new, it is believed that the roller described fills the gap between the standard wobble-wheel and the large airfield compactor and will be of interest to engineers throughout the country.



WILLAMETTE VALLEY soils compact easily under experimental roller, with body of 450-cu ft capacity which weighs from 20,000 to 80,000 lb when filled with sand and gravel. Four 18 × 24-in. tires are mounted on two axles which are free to oscillate longitudinally.

. . . THE READERS *Write*

Breakdown of Fee Estimates in "Interim Report" Presented

To the Editor: The accompanying table has been prepared in my office in connection with the "Interim Report: A Method of Estimating Fees for Professional Civil Engineering Services," printed in the August 1949 issue, and amended as of October 31, 1949.*

As many engineering engagements are for only the report phase, while other engagements are for the design, plans and specifications phase, not including either general or detailed supervision of construction (especially with municipalities), it seems to me to be desirable that some indication be given of a reasonable breakdown of the fee estimates so that a guide will be available to make a reduction of fee when some part or parts of the coverage is not to be included in the engineering proposal.

For this purpose, the table below attempts to make a breakdown between report, design and general supervision phases of ordinary projects estimated to cost $100,000, $500,000 and $2,000,000, both on "A" and "B" projects. The total fee, covering the 14 services used in the analysis, is the same as shown on the curves of the "Interim Report." The percentage fee opposite each service is considered to contain proportional payroll, overhead, direct expenses, and compensation to the engineer on projects of no unusual aspect. The actual percentages are, of course, subject to wide variations dependent upon the particular project being considered. The table is a statistical average of the independent judgments of five experienced engineers of this office.

This breakdown is presented in the hope that it will invite reader comment.

Gustav J. Requardt, M. ASCE
Partner, Whitman, Requardt and Associates, Consulting Engineers
Baltimore, Md.

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* Editor's Note: Now available in revised form, as a separate pamphlet (No. 1949-1 Revised) from Society Headquarters at 10 cents each, 5 copies for 35 cents, or 5 cents each in quantities of 10 copies or more.

BREAKDOWN OF FEE ESTIMATES FOR PROFESSIONAL CIVIL ENGINEERING SERVICES

	Work Covered by Fee Estimates	Net Construction Cost of Project, %					
		$100,000		$500,000		$2,000,000	
		A	*B*	*A*	*B*	*A*	*B*
1	Investigations and report	1.01	0.61	0.55	0.33	0.42	0.24
2	Assistance in procuring funds	0.22	0.22	0.11	0.11	0.06	0.06
3	Subsurface study	0.30	0.25	0.12	0.10	0.08	0.06
	A. **(Report Phase)**	(1.53)	(1.08)	(0.78)	(0.54)	(0.56)	(0.36)
4	Design, plans and specifications	4.94	4.12	4.03	3.46	3.61	3.09
5	Estimate of quantities and costs	0.42	0.32	0.27	0.22	0.21	0.16
	B. **(Plan Phase)**	(5.36)	(4.44)	(4.30)	(3.68)	(3.82)	3.25)
6	Assistance in securing bids	0.35	0.30	0.12	0.10	0.06	0.05
7	Analysis of bids						
8	Assistance in letting contracts						
9	Checking shop drawings	0.45	0.26	0.28	0.16	0.20	0.12
10	Advice during construction	0.50	0.30	0.33	0.20	0.25	0.18
11	Review of progress and payments to contractors	0.32	0.32	0.19	0.19	0.16	0.16
12	Assistance in tune-up and testing	0.30	0.19	0.20	0.13	0.11	0.09
13	Preparation of record drawings	0.27	0.22	0.20	0.16	0.15	0.12
14	Final inspection and report	0.17	0.14	0.11	0.10	0.09	0.07
	C. **(General Supervision Phase)**	(2.36)	(1.73)	(1.43)	(1.04)	(1.02)	(0.79)
	Total Fee, ASCE curves	9.25	7.25	6.51	5.26	5.40	4.40
	Summary of Engineering Service (Less surveys, land plots, printing, and field supervision):						
	A. **Report Phase**	1.53 (16.5%)	1.08 (14.9%)	0.78 (12.0%)	0.54 (10.3%)	0.56 (10.4%)	0.36 (8.2%)
	B. **Plan Phase**†	5.36 (58.0%)	4.44 (61.2%)	4.30 (66.0%)	3.68 (70.0%)	3.82 (70.8%)	3.25 (73.8%)
	C. **General Supervision Phase**	2.36 (25.5%)	1.73 (23.9%)	1.43 (22.0%)	1.04 (19.7%)	1.02 (18.8%)	0.79 (18.0%)
	Totals	9.25 (100.0%)	7.25 (100.0%)	6.51 (100.0%)	5.26 (100.0%)	5.40 (100.0%)	4.40 (100.0%)

† Note: The fees for location and land surveys and maps, and printing of plans and specifications sometimes requested by clients under "B. Plan Phase" services, in many cases are not less than, and vary with, the amount of fees shown for the total of "C. General Supervision Phase" services.

Many Factors Complicate Snow Surveying Procedures

To the Editor: An uninformed reader of Mr. Tonning's article on snow surveys in the October issue might infer that the method referred to is not only particularly advanced, but that the hazardous program described is essential. By way of background and perspective, it should be explained that the nation-wide streamflow forecasting service of the U.S. Weather Bureau includes the forecasting of seasonal water supply. The Weather Bureau however uses more comprehensive data and a less expensive and far less laborious method. Instead of basing the water supply forecast on the 75-percent component composed of snow, the Weather Bureau method relates all the runoff to all the precipitation—rain plus snow.

In addition to recognizing the importance of elevation as a factor in sampling precipitation, two of the other factors known to be important are direction of orientation and degree of slope. As pointed out by Mr. Tonning, it is hardly possible to sample the range of elevation by means of spring snow surveys, because, by the first of April, much of the snow has disappeared from low elevations. Sheltered flats or meadows are chosen for snow course sites so as to avoid undue effects of drifting and wind-swept snow. This practice restricts the sampling of the wide range of environments which occur in mountainous areas. The fact that many snow surveys are necessarily made on northerly slopes of mountains, so as to avoid the effects of early season melting by the sun, contributes further to the bias and inadequacy of sampling the snow pack. This orientation bias is particularly serious in localities where the inflow of moisture for important storms has a southerly component, such as in the Sierra Nevada.

As Mr. Tonning has indicated, fall precipitation is a factor to be considered in estimating the runoff for the following spring and summer. Stations measuring fall precipitation also measure it for the other seasons, including winter. Thus the snow surveyor's trips may not only be long and difficult, but actually are redundant with respect to one of the many purposes served for decades by thousands of precipitation gages.

Walter T. Wilson, Assoc. M. ASCE
Hydrologist, U.S. Weather Bureau
San Francisco, Calif.

Aircraft Manufacturers Seek Greater Precision Through Surveying Methods

To the Editor: The value of surveying methods in shop practice was well presented by Prof. Philip Kissam in the November issue. I am especially interested in that phase of his discussion which relates to the aircraft industry. The problem of building large aircraft components to finely controlled dimensions to ensure interchangeability is a major one, but it is not the only one that dictates the use of surveyors' precision instruments for fixture construction. (In this discussion the term "fixture" is used to mean a metal framework which locates and holds parts of an airplane in relation to one another while they are being joined together.)

The trend toward ever-increasing speed of aircraft necessitates the greatest possible accuracy in all dimensions, particularly of external surfaces, to insure performance in accordance with design calculations.

The setting up of the transit to coincide with an established line or plane is a laborious process—usually accomplished by stabilizing a plumb bob in an oil pot and using a lateral adjustment adapter to sight the instrument on the plumb-bob line.

The transit and level is a major factor in establishing the relationship of points or planes but in many cases this is accomplished in conjunction with a direct measuring instrument, such as a scale. Here one of the major deficiencies in common practice is encountered. Most measurements require a 6-ft scale, which is beyond the range of a conventional vernier height gage. The finest graduation on the scale is $^{1}/_{64}$ in., yet the toolmaker is required to set his point or surface to a tolerance of 0.004 in. Obviously all the accuracy obtained by using the optical sight can be lost in the final setting. A vernier-type rod reading to 0.001 in. with a 6-ft range would be a great asset.

As for the focal distance and magnification of the surveyor's transit and level, here the toolmaker would like to have his cake and eat it too. A focal distance of 2 ft with a 40-power magnification would be desirable as extremely short sights are sometimes required. Features of most engineering transits that could be eliminated for shop use are the vertical and horizontal circles. Rarely if ever are angular sights taken.

The British system of fixture construction using a telescope and collimator with intermediate targets is an interesting approach to the problem of controlled dimensions. Several American aircraft companies have purchased these instruments in England and are currently trying them out in fixture building. My company also has a set which is being used in a trial application on a forthcoming model. Definite conclusions as to its effectiveness cannot yet be drawn.

Another British development, conducted by Mr. H. Grafton and reported in a paper before the Institute of Production Engineers of England, is the use of high-precision theodolites to measure length in space by purely optical observation. The theodolites were used to sight a subtense bar using single and dual station calibration. In the test, different setups were made, some employing a pentag prism. The conclusion was that, allowing for errors of actual pointing, of the individual operator, of instrument setup and of instrument mechanics, measurements up to 20 ft can be made with a tolerance of ±0.005. If this method could be refined for general shop use, it would satisfy a definite need in fixture construction, as the present method of using tapes, scales and internal micrometers results in excessive errors and cannot always be satisfactorily applied because of obstruction in the line of measurement.

Other British applications of optics to tool-making that have attracted the attention of American aircraft production engineers are optical micrometers for taking direct readings from an optical sight and the auto-collimator for alignment.

The use of surveying practices for jig and fixture construction is in the embryo stage and any advice as to the proper application of known practices or the development of new ones will be welcomed by the aircraft industry.

Walter E. Green, *Supervisor,*
Manufacturing Research Unit,
The Glenn L. Martin Co.
Baltimore, Md.

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Amplifies Statement on Aerial Mapping Procedure

To the Editor: In my article on aerial survey methods in the Tropics, in the October issue, the statement made in the last sentence of the first paragraph, under the heading "Choice of Focal Length of Camera" (page 43), would be more complete if written:

"Generally, the precision of topographic maps made by photogrammetric methods is increased with an increase in the scale of the aerial photographs that are used. The scale can be increased in two ways: (1) By flying lower with the aerial camera, or (2) by increasing the focal length of the camera. For economic reasons, however, mappers and designers of photogrammetric equipment have, within practical limits, worked toward flying lower and using cameras of the shorter focal length. Thus available photogrammetric equipment is selected accordingly whenever large-scale, small-contour-interval mapping is required."

The desirability of making this amplification was called to my attention by W. S. Higginson of the U. S. Geological Survey.

William T. Pryor, Assoc. M. ASCE
U.S. Bureau of Public Roads
Washington, D.C.

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Assumptions in Soil Bearing Tests Weighed

To the Editor: In the October issue Prof. Evan W. Vaughan, M. ASCE, of Syracuse University, presented an article describing the use of field bearing tests in verification of laboratory findings. On the basis of the excellent correlations obtained, Professor Vaughan suggests that bearing tests of the type described be employed on similiar projects. The writer therefore wishes to call attention to the significance of certain basic assumptions made in this article.

First of all, the soil was a weathered mica schist and because of the geological characteristics of the parent rock, such a soil usually has some degree of foliation. Consequently, a non-uniform soil structure is developed and non-isotropic behavior is a common property of this residual soil. Therefore, jacking the bearing plate laterally against the vertical pit wall would probably not yield the same values as a conventional surface bearing test. Since it is assumed that vertical stress-strain relations are being determined, it is apparent that lateral stresses, unless coincidental, would probably not give the desired solution.

Another property of weathered mica schists is lack of homogeneity. Experiences in the New York area with this type of soil have shown that great variations in physical characteristics and structure are the rule. As a consequence, any soils investigation of this material must necessarily determine "average values." Therefore, an extensive, but economical, testing program is in order. Conclusions should not be based on only a few test results. The above discussion applies to any soil having non-isotropic properties, such as the mica schist.

Another, more fundamental assumption made in the article concerns Poisson's ratio, which is defined as unit lateral contraction or expansion divided by unit axial contraction. Professor Vaughan uses 0.5 as this ratio value. For this ratio the volume change of the soil mass, under load deformation, would have to be zero. On some tests, this 0.5 ratio has been found to exist, but the average Poisson ratio for sand is about 0.3 and for clay 0.4, or slightly more. Another important fact is that for dense soils, Poisson's ratio increases with increasing load. Consequently, although the effect of Poisson's ratio is not very large on the determined stresses, it is necessary to realize that this ratio value is unknown, and in applying formulas that are based on elastic theories in which Poisson's ratio is a supposedly known constant, an estimate must be made.

Finally, there is the assumption made for the coefficient of active pressure. Professor Vaughan used one-half. In order to have such a relatively high coefficient, the angle of internal friction must be very low—approximately 20 deg. Considering the fact that the lowest angle of internal friction obtained from direct shear tests was 29 deg, this assumption of one-half appears unjustified. On the other hand, if Professor Vaughan had in mind the coefficient of earth pressure at rest, this assumption of one-half appears reasonable, but then the existence of the open pit and resulting decreased horizontal stress is apparently neglected.

In conclusion, the writer wishes to point out that some laboratory tests are necessary in conjunction with the field bearing test. Also, the test load stress should act in the same direction as the anticipated structural stress loads.

Stephen M. Olkó, Jun. ASCE
Manhasset, Long Island, N.Y.

Term in Dam Uplift Equation Questioned and Defended

To the Editor: In Kenneth B. Keener's paper on "Uplift Pressures in Concrete Dams Constructed by the Bureau of Reclamation" (reviewed in the November issue, page 52), one of the formulas for the design of cross sections of gravity dams is given as follows:

[*] Shear-friction factor =

$$\frac{(\text{Weight} - \text{Uplift}) \times \text{Coefficient of internal friction} + (\text{Horizontal area} \times \text{Unit shear resistance})}{\text{Horizontal force}}$$

I question Mr. Keener's use of the word "internal" in the "coefficient of internal friction." Most authorities use "coefficient of *static* friction" in this connection, and define the value of this coefficient as that for "well-dressed specimens." I would like to know if the term "coefficient of internal friction" is really intended, as I have previously noticed its use only in connection with such materials as sand and earth.

Carvel B. Case, Assoc. M. ASCE
Portland, Ore.

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[*] Editor's Note: A typographical error occurred in this formula as printed in Civil Engineering for November, page 52, in that a minus sign instead of a plus sign was printed before the term "(Horizontal area × Unit shear resistance)."

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To the Editor: The formula in which the term coefficient of internal friction was used was derived by the late D. C. Henny, M. ASCE ("Stability of Straight Concrete Gravity Dams," Transactions of ASCE, 1934, p. 1041), making use of the internal friction theory originated by Coulomb. It was used in my paper solely to show how uplift affects the shear friction factor, one of the safety factors used in the design of concrete dams.

It appears that the word "internal" is the correct adjective to define the general location of the friction. It applies to the friction within the body of a mass, such as the concrete, or concrete and the foundation rock, which in characteristics are not widely dissimilar and which by construction methods are made monolithic. The compactness of sand and earth as compared with concrete and rock is only relative. Thus, it is believed that the term internal friction as used by Coulomb in his theory may be used correctly for any of the materials mentioned.

Kenneth B. Keener, M. ASCE
U. S. Bureau of Reclamation
Denver, Colo.

Remedies for Oil-Field Subsidence Considered

To the Editor: Commander Coxe, in the November issue, has excellently stated the background of the Long Beach Naval Shipyard subsidence problem. Reference to the subject would be incomplete, however, if it were not pointed out that almost without exception each investigator has listed among the contributors to the subsidence, besides oil production, tectonics, natural settlement of the sediments in the area, vibrations, pressure drawdown in shallow water-bearing sands due to pumping activity related to construction and dewatering, water-pressure drawdowns in deeper sands due to pumping of fresh water, loading of the area with imported materials, vibrations, and migration of waters from zone to zone due to penetration of the zones with drill holes. True, these investigators minimize the effect of the causes other than oil production.

There has been an inclination among investigators to limit their thinking to a very restricted ellipse of subsidence having an area only about 20 percent as great as that properly described by Commander Coxe. There is likewise an inclination to overlook the measured volumes of subsidences existing far beyond the limits of, but contiguous to, the producing oil field. These volumes seem important for they exceed the volumes over the oil-producing areas. The Wilmington oil-field disturbance is a pronounced localized subsidence superimposed upon a general plane of subsidence extending over possibly 100 to 150 square miles. A pronounced subsidence ellipse coincides with the shape of the Signal Hill oil field, the center of which is about four miles from the Wilmington field. The evidence is thus strong that pressure reduction is occurring in water-bearing sands contiguous to the suspected oil sands, and that edgewaters are encroaching at an appreciable rate.

Annual and total losses due to an improper approach to the remedy in an industry of such magnitude as the Wilmington oil field and its dependent industries, producing, processing, selling, distributing and using from $80,000,000 to $100,000,000 worth of crude oil annually, can be much larger than subsidence losses if good judgment is not made the basis of action. One of the remedies urgently proposed is production curtailment and the other is water repressuring of the oil sands. Both remedies have been urged without presentation of much evidence to indicate their effectiveness, but all possible meanings of the data available have not yet been fully determined.

The slight assumed slowing down of the rate of subsidence as recorded by November 1948 Navy level runs following a nearly 20 percent reduction in production during an oil strike in September 1948, must be dismissed as of no moment, for the deviation from the trend following that short curtailment was only consistent with numerous previous deviations which were not significant. Marked

(*Continued on page 92*)

SOCIETY NEWS

United Nations to Be Theme of ASCE Annual Meeting

Creation of the United Nations permanent headquarters and the civil engineer's part in attaining the objectives of the United Nations will be focal points for discussion at several of the numerous sessions planned for the ASCE Annual Meeting, to be held at the Hotel Commodore in New York, January 18-20. For the traditional Thursday Construction Luncheon the Construction Division is featuring a panel of experts connected with the planning, design, and construction of the Secretariat Building, first unit in the $23,809,573 permanent United Nations headquarters project under construction a few blocks east of the Commodore. As usual a Thursday afternoon session of the Construction Division will continue the panel discussion begun at the luncheon.

A tour of the United Nations Headquarters Project, under the auspices of the Construction Division, will conclude the Thursday afternoon program. Details of the unique construction project will be explained by guides supplied by Fuller, Turner, Slattery & Walsh, combined contractors for the work. The "United Nations in Action" will be the objective of a Friday excursion to the temporary headquarters of the United Nations at Lake Success. After luncheon in the staff cafeteria, the group will be addressed by a U.N. speaker and will attend a session of the U.N. Committee.

Nine Technical Divisions, in addition to the Construction Division, have scheduled one or more sessions in a program notable for its scope and variety. The program of speakers and their papers was printed in the December issue.

Prizes and Medals to Be Awarded

Sharing the spotlight with the Technical Division sessions will be the annual Wednesday morning business meeting, at which prizes and awards for the year will be presented and honorary membership will be conferred on five engineers. Biographies of the prize winners and new honorary members appear elsewhere in this section.

The Wednesday noon membership luncheon will be addressed by Nelson A. Rockefeller, president of the International Basic Economy Association, on "The Role of Engineers in World Affairs."

Variety of Entertainment Offered

Social highlight of the Annual Meeting will be the formal dinner dance scheduled for Wednesday evening, January 18. The Grand Ballroom of the Commodore will be the scene of this colorful event, which offers an excellent opportunity for reunion with old friends and business acquaintances. Music for dancing will be furnished by Harry Lefcourt and his popular orchestra.

On Thursday evening of the Annual Meeting week two strictly informal entertainments are offered. The Men's Smoker, which has never been classified among the erudite sessions of the Annual Meeting program, will offer enjoyable new features, in addition to a show, refreshments, group singing, and the smoking. To entertain the women on the evening of the smoker, a Ladies' Sociable has been planned, with the program for the occasion featuring a talk on "The Lure of Collecting."

The Century Room of the Commodore will be the scene of the annual Fashion Show and Tea for ladies on Thursday afternoon. Adele Simpson, prize-winning designer of women's clothing, will produce the show that will feature spring fashions.

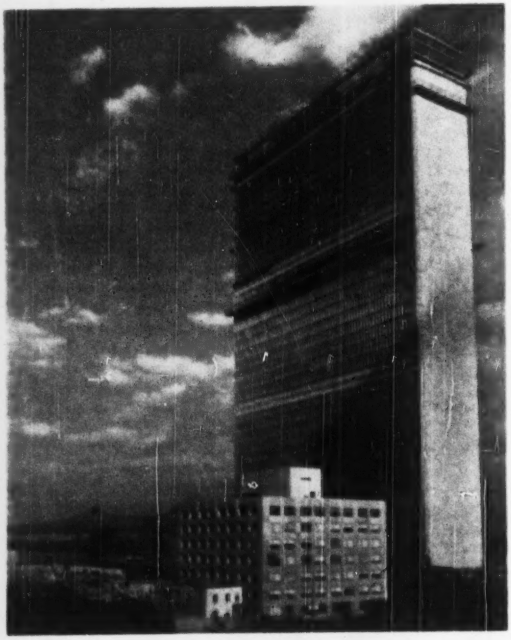
Student Chapter Conference

Both students and practicing engineers will take part in a Student Chapter Conference, which the Metropolitan Conference of ASCE Student Chapters is sponsoring on Wednesday afternoon. Students from all the Chapters in the New York metropolitan area have signified their intention of attending.

College Reunions

As usual alumni of a number of colleges have planned reunion dinners during the meeting week. Several will coordinate their dinner meetings with the Thursday evening smoker, which has timed all events to accommodate those attending special dinners. To the list of colleges and engineering fraternities scheduling reunions that appeared in the December issue should be added the annual meeting of the New York Section of Clarkson College, at the Hotel Astor on the afternoon and evening of January 21.

Thursday evening the Institute of Traffic Engineers, New York Metropolitan Section, invites members of ASCE to take part in its dinner meeting, to be held at the President's Tavern, Lexington Avenue at 41st Street. The program has been arranged to permit attendance at the smoker.



CONSTRUCTION PROCEEDS at rapid pace on 42-story United Nations Secretariat Building that will be objective of ASCE Annual Meeting inspection trip. Secretariat Building, which will have capacity of 3,200 persons, will service Councils and Assembly Buildings, next to be constructed in permanent U.N. Headquarters project. Secretariat Building will be ready for occupancy late in 1950.

Society Prizes and Medals Will Be Awarded

Biographies of 14 Engineers, to Be Honored for Notable Papers at ASCE Annual Meeting, Summarized

GERARD H. MATTHES

A BOYHOOD INTEREST in stream flow provided the incentive that has made Gerard H. Matthes, recipient of the Norman Medal, an authority on problems relating to navigation, water power, and flood control. The subject of his prize-winning paper is "Mississippi River Cutoffs." Born in Holland, Mr. Matthes received a cosmopolitan education covering four years in Dutch schools, four years in Swiss private schools, and four years in high school at Frankfort-on-Main. Coming to the United States in 1891, he then started the study of civil engineering at Massachusetts Institute of Technology, from which he graduated four years later.

In 1897 Mr. Matthes received a Civil Service appointment as junior engineer in the newly established stream-gaging branch of the U.S. Geological Survey. This work was followed by five years with the U.S. Reclamation Service (now the Bureau of Reclamation) on projects in Colorado, Oklahoma, Arizona, New Mexico, Idaho, and California; seven years in the water power field—first with the Colorado Power Co. (now Public Utility of Colorado) and later for the Hydro-Electric Co. of West Virginia; and five years on the engineering staff of the Miami Conservancy District at Dayton, Ohio.

Placed in charge of surveys of the Tennessee River for the Corps of Engineers in 1920, Mr. Matthes conceived a plan for utilizing aerial photographs as a base. This plan led to the first aerial survey of a navigable river made by the Army Corps of Engineers, which is described by Mr. Matthes in Volume 86 of TRANSACTIONS. His work for the Corps of Engineers there also included planning a system of dams for navigation and power development, with incidental flood control benefits. Later he was principal engineer in the U.S. District Engineer Office at Norfolk, Va., where he organized surveys for river development in Virginia and North Carolina. In the latter post, he also assisted in developing plans for shortening the lower Mississippi River by means of cutoffs, in order to lower flood stages and stabilize its course. In 1932 Mr. Matthes was transferred to the Office of the President of the Mississippi River Commission in Vicksburg, and the system of cutoffs was put into effect during the course of the next ten years. The paper describing the cutoffs, for which Mr. Matthes is awarded the Norman Medal, appeared in Volume 113 of TRANSACTIONS.

Mr. Matthes was promoted to head engineer in the Office of the President of the Mississippi River Commission in 1942, and with the outbreak of the war assumed additional duties as director of the Waterways Experiment Station. In recognition of his services in these capacities, he was awarded the Exceptional Civilian Service Medal by the Secretary of War in 1944. Mr. Matthes retired in 1945 and is now engaged in consulting practice in New York City, specializing in river and harbor problems.

A corporate member of ASCE since 1900, Mr. Matthes was elected to honorary membership in 1943. He has served on several flood committees of the ASCE, and since 1941 has been chairman of the Joint Committee on Floods of the Hydrology Division. He has also served on a special TVA consulting board on flood control and as consultant on Mississippi River flood control to such agencies as the Public Works Administration and the National Resources Committee. Throughout his career, Mr. Matthes has figured prominently as an expert witness in law suits on behalf of the Miami Conservancy District, the Mississippi River Commission, and corporations.

Since his retirement Mr. Matthes has served as consultant for a number of projects here and abroad, including irrigation in the Cauca River Valley, Colombia, and the rectification of the Papaloapan River for the Mexican Ministry of Hydraulic Resources. He is author of more than fifty papers in engineering publications, and holds membership in many professional societies.

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F. H. KELLOGG

THIS YEAR THE J. James R. Croes Medal goes to F. H. Kellogg, chairman of the civil engineering department at the University of Mississippi, for his paper, "Investigation of Drainage Rates Affecting Stability of Earth Dams." Mr. Kellogg was educated at the Colorado School of Mines, receiving the degree of G.E. in 1927. In 1929 he received the degree of M.A. in geology from the Johns Hopkins University, and in 1934, the degree of Ph.D. in geology

GERARD H. MATTHES
Norman Medal

F. H. KELLOGG
J. James R. Croes Medal

H. M. WESTERGAARD
Thomas Fitch Rowland Prize

ARTHUR CASAGRANDE
Arthur M. Wellington Prize

NORMAN MEDAL, ESTABLISHED IN 1872 by the late George H. Norman, M. ASCE, is the oldest and most notable of ASCE awards. Considered next in distinction is J. James E. Croes Medal, which was established in 1912 and named for first recipient of Norman Medal. The late Thomas Fitch Rowland, Hon. M. ASCE endowed the prize bearing his name, in 1884, for a paper best describing some accomplished work of construction. The Arthur M. Wellington Prize for the best paper dealing with some phase of transportation was endowed by "Engineering News-Record" in 1921.

applied to civil engineering, from the same institution.

From the end of 1929 to 1934, Mr. Kellogg was employed by the Panama Canal. During this period, he directed field investigations for the Madden Dam Project, developed a method of pressure grouting with clay which was used on the cavernous limestone in the reservoir ridges, and worked on foundation treatment for the concrete dam and soils engineering for the 18 appurtenant earth dams. Joining the Construction Department of the Tennessee Valley Authority in 1934, he was employed on earthworks and highway construction for the Pickwick, Guntersville, and Chickamauga dams, and from 1939 to 1945, he was in charge of soils and foundations work for the TVA during its accelerated wartime construction program. In 1945 and 1946, he worked on investigations for the Buffalo District of the U.S. Engineers, and later was in charge of the soils and Geology Section of the Missouri River Division of the U.S. Engineers, during the initial construction stages of the dams of the Pick-Sloan plan. In 1946 he joined the staff of the University of Mississippi as professor of civil engineering, becoming chairman of the department in 1947.

His consulting work has included grouting on the Santee Cooper Project in South Carolina; materials investigations for the Garza's and Dos Bocas projects of the Puerto Rico Reconstruction Administration; and inspection of seepage and dock foundations for the Panama Canal. He has present contracts as consulting engineer for the Construction Department of the TVA and for the Government of the Province of Bombay, India.

A member of ASCE since 1942, Mr. Kellogg has served on the Subcommittee on Measurement of Pore Water Pressures in Earth Dams of the Soil Mechanics and Foundations Division. He is on the Committee for Construction Education of the American Society for Engineering Education, and an honorary member of the Mississippi chapter of Chi Epsilon.

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H. M. WESTERGAARD

H. M. Westergaard, Gordon McKay Professor of Civil Engineering at Harvard University, is winner of the Thomas Fitch Rowland Prize for his paper, "New Formulas for Stresses in Concrete Pavement of Airfields." A native of Denmark, he received a B.S. degree in civil engineering from the Royal Technical College in Copenhagen in 1911. After work on the design of reinforced concrete in Copenhagen, Hamburg, and London, he studied in Göttingen and Munich. Awarded a fellowship of the American Scandinavian Foundation in 1914, his choice of the University of Illinois was made for the purpose of studying concrete and reinforced concrete under Prof. Arthur N. Talbot. In 1916, after two years of study, he received the Ph.D. degree from the University of Illinois. Professor Westergaard also holds some honorary degrees from universities in this country and abroad.

He was on the University of Illinois faculty from 1916 to 1936—from 1927 on as professor of theoretical and applied mechanics. While on leave of absence from the university in 1929 and 1930, he was in the Bureau of Reclamation as senior mathematician dealing with the structural problems of Hoover Dam, and later served the Bureau as consultant. In 1936 Professor Westergaard went to Harvard University as Gordon McKay Professor of Civil Engineering, and from 1937 to 1946, he was also dean of the Graduate School of Engineering.

A consulting structural engineer to the Navy Bureau of Yards and Docks, Professor Westergaard was also an officer in the Civil Engineer Corps Reserve. During the war he served on several tours of active duty and was a member of a Bureau of Yards and Docks mission to Japan in 1945. In 1946 and 1947 he was consultant to the Panama Canal.

Professor Westergaard has written extensively on structural mechanics and the theory of elasticity, receiving the Society's J. James R. Croes Medal in 1934 for a paper in TRANSACTIONS, and the Wason Medal of the American Concrete Institute. He has been a corporate member of ASCE since 1922. His other technical affiliations include the American Concrete Institute, the Boston Society of Civil Engineers, the American Philosophical Society, the American Society of Mechanical Engineers, and the American Society for Engineering Education.

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GEORGE H. HICKOX

George H. Hickox, this year's winner with A. J. Peterka and R. A. Elder of the James Laurie Prize, received the Society's Collingwood Prize for Juniors in 1934 and the J. James R. Croes Medal in 1945. A specialist in hydraulics, Mr. Hickox recently left the staff of the Tennessee Valley Authority, where he was head of the hydraulic laboratory, to become associate director of the Engineering Experiment Station at the University of Tennessee, Knoxville.

Mr. Hickox was educated at the State University of Iowa, receiving B.E. and M.S. degrees in hydraulic engineering in 1925 and 1926. After two years as instructor in mathematics at Albion College, Albion, Mich., he spent five years with various engineering firms, including the West Virginia Power and Transmission Co. and the Morgan Engineering Co. on varied work. In 1932 he returned to teaching at the University of California, where he taught hydraulics and engaged in hydraulic research and graduate work that culminated in his winning the Ph.D. degree in 1939. As head of the hydraulic laboratory at the TVA from 1935 until recently, he was in charge of all hydraulic model tests on TVA dams and other structures.

G. H. HICKOX

A. J. PETERKA

R. A. ELDER

JAMES LAURIE PRIZE, which was established by the Society in 1912 and named in honor of the first President, goes to Messrs. Hickox, Peterka, and Elder, for joint paper on "Friction Coefficients in a Large Tunnel."

ALFRED MACHIS
Collingwood Prize for Juniors

DONALD E. BLOTCKY
J. C. Stevens Award

VITO A. VANONI
Karl Emil Hilgard Prize

ALEXANDER HRENNIKOFF
Leon S. Moisseiff Award

COLLINGWOOD PRIZE FOR JUNIORS was established in 1894 by the late Francis Collingwood, M. ASCE, on his retirement as Secretary of the Society. Papers eligible for this award must describe an engineering work or investigation with which the author has been connected. The J. C. Stevens Award, established in 1943, is given annually for best discussion of paper in the field of hydraulics. Endowed in 1939 by bequest of the late Karl Emil Hilgard, M. ASCE, of Zurich, Switzerland, the Hilgard Prize is awarded biennially under the auspieces of the Hydraulics Division. The Moisseiff Award was established in 1947 in honor of the late Leon S. Moisseiff, M. ASCE, for the best paper in the field of structural analysis. It is administered by the Structural Division.

A full member of the Society since 1940, Mr. Hickox has served on the Committee on Hydraulic Research and its Subcommittee on Cavitation in Hydraulic Structures and other research committees. He is author, with M. P. O'Brien, of *Applied Fluid Mechanics* (1937) and a contributor to the *Handbook of Applied Science*.

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ALVIN J. PETERKA

An expert in the conduct of hydraulic model studies is Alvin J. Peterka, Assoc. M. ASCE, co-winner of the James Laurie Prize. Following his graduation from the Case Institute of Technology in 1934, Mr. Peterka was retained by the civil engineering department for a year to make hydraulic model studies for the U.S. Engineers of 15 flood-control dams of the Muskingum Valley Project in Ohio. Following this assignment, he was employed by the Corps of Engineers on the construction of Tappan Dam near Dennison, Ohio.

In February 1936, Mr. Peterka joined the staff of the hydraulic laboratory of the Tennessee Valley Authority at Norris, where he was engaged in research and development work on the large TVA dams. Much of the work consisted of building, testing, and reporting on the hydraulic performance of model dams, spillways, locks and machinery. During the war he was retained by the TVA to expedite the development of hydraulic designs for Douglas and Fontana dams that were being rushed to completion to provide electric power for war uses. He was also in charge of some of the tests made on the full-sized completed structures that had been built in accordance with recommendations resulting from model tests. The model-prototype performance comparisons included navigation locks, spillways, stilling basins, turbines, tunnels, sluices, and other special devices. It was one of these prototype tests that prompted the writing of the prize-winning paper.

In July 1946 Mr. Peterka was employed in the hydraulic laboratory of the U.S. Bureau of Reclamation in Denver, to conduct model studies on the large reclamation dams of the West and on Missouri River Basin projects. There he has been responsible, particularly, for developing new concepts in the design of outlet works stilling basins. Interested also in improving the quality of engineers' reports, Mr. Peterka has prepared a manual on the writing of technical reports which is now in use in the Denver office.

He is now also acting as a consultant for the hydraulic laboratory of the Colorado A. & M. College at Fort Collins, which has contracted to conduct the model tests necessary for the design of the Bhakra, Hirakud, and Rihand dams in India.

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REX A. ELDER

Rex A. Elder, co-winner of the James Laurie Prize, is at present employed by the Tennessee Valley Authority in the Hydraulic Data Branch of the Water Control Planning Division as head of the Hydraulic Laboratory Section. Mr. Elder graduated in 1940 from Carnegie Institute of Technology, with a B.S. in C.E. degree, and in 1942 received a M.S. degree with a major in hydraulic engineering from Oregon State College. He has been in the Hydraulic Laboratory at Norris since April 1942, with the exception of the year from April 1945 through May 1946, when he served in the Navy.

Mr. Elder was elected a Junior in the ASCE in 1940 and transferred to Associate Member in 1947. His other professional affiliations include membership in the American Geophysical Union, Sigma Xi, and Phi Kappa Phi.

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ARTHUR CASAGRANDE

Known for his accomplishments in the teaching and practical application of soil mechanics, Arthur Casagrande receives the Arthur M. Wellington Prize for a paper on "Classification and Identification of Soils." At present he is professor of soil mechanics and foundation engineering at Harvard University, and he recently returned from a lecture tour of Brazil, Argentina, Chile, and Mexico.

Dr. Casagrande graduated in 1924 from the Technische Hochschule in Vienna, where he also received the doctor's degree in 1933. From 1924 to 1926 he was assistant there in hydraulics and sanitary engineering and worked also on tunnel construction in the Alps.

Immigrating to the United States he started as a draftsman with the Carnegie Steel Co. Later he became private assistant on consulting projects to Prof. Karl Terzaghi and, on his recommendation, was employed by the U.S. Bureau of Public Roads as research assistant at the Massachusetts Institute of Technology under a cooperative agreement with the Institute. In 1929 he assisted Dr. Terzaghi in establishing a soils laboratory in Vienna and in training a staff. Upon his return to the United States in 1930, he continued his work with the U.S. Bureau of Public Roads. Since 1932 he has had a lectureship at Harvard University, where he developed a well-known soil mechanics laboratory.

Dr. Casagrande organized the First International Conference on Soil Mechanics and Foundation Engineering, which met in 1936 in Cambridge as a part of the Harvard Tercentenary Celebration. During the war he organized and conducted special courses for Army Engineer officers on "Control of Soils in Military Construction."

He has served as consulting engineer on earth work and foundation projects to numerous federal, state, municipal and private engineering organizations. Since 1936 he has been extensively employed by the Corps of Engineers on river and harbor works, and since 1940 has served as consultant to the Panama Canal in connection with the design of the Third Locks Project and of studies for a sea level canal.

Dr. Casagrande has published numerous papers, including contributions to the ASCE Proceedings. He is a member of the ASCE, the Boston Society of Civil Engineers (he has won the Desmond Fitzgerald Medal, the Clemens Herschel Prize and the Structural Section Prize of the latter organization), the American Society for Engineering Education, Highway Research Board, American Geophysical Union, American Concrete Institute, Harvard Engineering Society, Sigma Xi and American Academy of Arts and Sciences.

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ALFRED MACHIS

Alfred Machis, winner of the Collingwood Prize for Juniors for his paper, "Experimental Observations on Grouting Sands and Gravels," is director of public works of Anne Arundel County, Maryland.

Mr. Machis received his bachelor of engineering degree in 1941 and his doctor of engineering degree in 1944 from the Johns Hopkins University, where he specialized in the sanitary engineering option of the civil engineering course. During the period 1944 to 1946, as a commissioned officer of the Corps of Engineers, he saw service in both theatres of war. In 1946 and 1947 he was a research analyst with the Maryland State Planning Commission engaging in the assembly of several public works studies. From 1947 to 1949 he was research associate in sanitary engineering at the Johns Hopkins University, making a special study of the fundamental characteristics of various types of filtering media in pressure type filters. He also taught hydraulics in the McCoy College of the university.

In addition to working toward his degree, Mr. Machis was also employed as an engineer by the Washington Suburban Sanitary Commission in 1941. In 1942 and 1943, he was in the consulting office of Robert T. Regester on the design of several sanitary engineering projects, and in 1943 and 1944, he taught several courses at Johns Hopkins.

Mr. Machis joined the ASCE as a Junior in 1941. His other professional affiliations include membership in Sigma Xi and the American Water Works Association.

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VITO A. VANONI

As associate director of the Hydrodynamics Laboratory at the California Institute of Technology, Dr. Vito A. Vanoni, winner of the Karl Emil Hilgard Prize, is connected with studies of cavitation, underwater ballistics, hydraulic machinery, sediment transportation, density currents, harbors, and hydraulic structures. His prize-winning paper is on "Transportation of Suspended Sediment by Water."

He graduated from the California Institute of Technology in 1926, and received an M.S. degree from the same institution in 1932 and a Ph.D. in 1940. From 1926 to 1931, he was employed by the American Bridge Co. and the Bethlehem Steel Corp. in various phases of the steel fabricating industry. After receiving his master's degree, he remained at the Institute as research assistant and research fellow engaged in hydraulic laboratory investigations of streams discharging into the ocean in the Los Angeles area. From 1935 to 1947, he was supervisor of the cooperative laboratory of the U.S. Department of Agriculture, Soil Conservation Service, and the Institute, which was located on the campus at Pasadena. The laboratory studied a variety of hydraulic problems, ranging from basic density current and sediment transportation mechanics to the design of hydraulic structures.

During the war, Dr. Vanoni spent much of his time in the Hydrodynamics Laboratory of the California Institute of Technology, working on military developments of underwater ordnance. He was assistant professor of hydraulics at the Institute from 1942 to the fall of 1949, and since that time has been associate professor of hydraulics.

Dr. Vanoni became a Junior in the ASCE in 1926, Associate Member in 1937, and a full member in 1947. He has served on the Fluid Mechanics Committee of the Hydraulics Division of the Society since the formation of the committee in 1945, and has been chairman of the committee since January 1948.

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DONALD E. BLOTCKY

Donald E. Blotcky, winner of the J. C. Stevens Award for his discussion of the paper "Development and Hydraulic Design, Saint Anthony Falls Stilling Basin," has been in the Dallas office of the Prudential Insurance Company of America since 1948.

Graduating from the University of Missouri in 1939, with a B.S. in civil engineering, Mr. Blotcky became a field engineer for the International Boundary Commission at McAllen, Tex. In March 1941 he entered the army and was assigned to the 111th Engineers of the 36th Division, as second lieutenant in the Corps of Engineers. Later assignments included resident engineer for the Corps of Engineers at Northway, Alaska, on construction of an emergency landing field; a 30-month tour of duty at Adak, Aleutian Islands; and instructor at the Engineer School at Ft. Belvoir, Va., teaching map reading and aerial photographic interpretation. He was separated from the service with the rank of major.

Mr. Blotcky returned to Fort Worth, Tex., as hydraulic engineer at the U.S. Engineer Sub-Office, which was engaged on the design of flood control and water conservation dams of the upper regions of the Trinity River. In 1947 he was design engineer for T. C. Forrest, Jr., consulting engineer of Dallas.

Mr. Blotcky is an Associate Member of ASCE, a registered professional engineer of the State of Texas, and a self-styled "amateur mathematician."

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ALEXANDER HRENNIKOFF

Winner of the Leon S. Moisseiff Award is Alexander Hrennikoff for his authorship of a paper on "Theory of Inelastic Bending with Reference to Limit Design." A native of Moscow, Mr. Hrennikoff was graduated from the Institute of Ways of Communication there in 1920. In 1925, after railroad and construction experience in Russia and Manchuria, he went to Vancouver, B.C., to make his home. There he attended the University of British Columbia, receiving the degrees of B.A.Sc. and M.A.Sc. in civil engineering.

Between 1929 and 1933 Mr. Hrennikoff worked as detailer and designer of steel frames and bridges for the Dominion Bridge Co. In 1933 he was appointed an instructor in civil engineering at the University of British Columbia, where he gradually rose in rank to his present position of professor of civil engineering. Between 1938 and 1940, while on leave of absence, he attended the Massachusetts Institute of Technology, receiving the doctor of science degree in structural engineering. He has spent many summers on design work in connection with various engineering projects in the province, and has taken a prominent part in his university's postwar expansion program, planning its new engineering building and designing equipment for the materials testing and hydraulics laboratories.

Dr. Hrennikoff has devoted much of his time to theoretical research in the fields of applied mechanics and structural engineering, and the results of his investigations have been presented in a number of papers published in the engineering journals of this country and Europe. In addition to being an Associate Member of ASCE, he also belongs to the Engineering Institute of Canada, the International Association for Bridge and Structural Engineering, and the Association of Professional Engineers of the Province of British Columbia.

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FRED W. BLAISDELL

THE FIRST RECIPIENT of the James W. Rickey Medal is Fred W. Blaisdell for his paper, "Development and Hydraulic Design, Saint Anthony Falls Stilling Basin." Mr. Blaisdell is research project supervisor for the Soil Conservation Service at the Saint Anthony Falls Hydraulic Laboratory, University of Minnesota.

FRED W. BLAISDELL
James W. Rickey Medal

INTENDED TO ENCOURAGE studies in the hydroelectric field, the James W. Rickey Medal was established by Mrs. Rickey in honor of her husband, and authorized by the Board of Direction in 1947. The award is made for the first time this year.

Mr. Blaisdell's career has been devoted entirely to hydraulic research. He received the B.S. degree in civil engineering from the University of New Hampshire in 1933, and the M.S. degree from the Massachusetts Institute of Technology, where he specialized in hydraulics and water power engineering, in 1934. He returned to M.I.T. following his graduation to become technical assistant for studies made on a tidal model of the Cape Cod Canal and its proposed enlargements. Since late in 1935 he has been employed by the Soil Conservation Service of the U.S. Department of Agriculture, first as station engineer on hydrologic research at its Soil Conservation Experiment Station, Pennsylvania State College; from 1936 to 1940 at the National Hydraulic Laboratory, National Bureau of Standards in Washington, D.C.; and since 1940 at the Saint Anthony Falls Hydraulic Laboratory. Since 1943 Mr. Blaisdell has been in charge of research on soil conservation structures being conducted at the university in cooperation with the Minnesota Agricultural Experiment Station and the Saint Anthony Falls Hydraulic Laboratory.

While in Washington Mr. Blaisdell worked on hydraulic instruments used in soil conservation research, including the development of a portable artificial rainfall apparatus for hydrologic research, the testing of many types of commercial water level recorders, and the calibration of devices for measuring runoff from small watersheds. In Minneapolis, where he has been conducting research on some of the hydraulic problems encountered by the Operations Division of the Soil Conservation Service, his efforts have been directed largely toward the generalization of designs for soil conservation structures such as the Saint Anthony Falls stilling basin, for which the Rickey Medal is being awarded.

Mr. Blaisdell joined ASCE as a Junior in 1933, and since 1945 has been an Associate Member. He has contributed several papers and discussions to Society publications.

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S. L. McFarland and William H. Blair Win Mead Prizes

THIS YEAR'S RECIPIENTS of the Daniel W. Mead Prizes for the best essays on a subject involving professional ethics are Sidney L. McFarland, Jun. ASCE, winner in the Junior category, and William H. Blair, of the University of California Student Chapter, who receives the Student Chapter award. Both wrote on the subject, "Under what conditions, and to what extent, is it ethical for an engineering society, such as a Local Section of the ASCE, to make studies and recommendations, without remuneration, on proposed public projects?"

A graduate of the Georgia School of Technology, class of 1939, Mr. McFarland was employed by the Central of Georgia Railway and the Georgia State Highway Department until called into the Army as second lieutenant. After duty at the District Engineer's Office at Savannah, he served with Engineer Combat Battalions in four campaigns in the European Theater, commanding the 275th Engineer Combat Battalion at the time of its deactivation in November 1945. Since early in 1946 Mr. McFarland has been employed in

S. L. McFARLAND, JUN. ASCE, SACRAMENTO (left) and William H. Blair, member of University of California Student Chapter, are 1949 winners of Daniel W. Mead Prizes for their essays on professional ethics. These prizes were established in 1949 by the late Daniel W. Mead, Past-President and Honorary Member.

the Sacramento, Calif., office of the Bureau of Reclamation—at present in the Allocation and Economics Division, Branch of Project Planning.

A member of the Student Chapter at the University of California, where he is completing his undergraduate work in sanitary engineering, William H. Blair is employed part-time as assistant traffic engineer for the City of Berkeley. He is a member of Tau Beta Pi and Chi Epsilon.

Careers of Five New Honorary Members Summarized

CHARLES B. BREED

As an educator, author of engineering textbooks, and consulting engineer, Charles B. Breed, professor emeritus of civil engineering at Massachusetts Institute of Technology, is probably known as much in one field as in the others. He is still active in the field of transportation engineering and economics.

Born in Lynn, Mass., he graduated from M.I.T. in 1897. He returned to Technology the following year, after brief employment in the engineering department of the Boston & Albany Railroad, as an assistant in the Civil Engineering Department. From 1901–1907, he was instructor; 1907–1910, assistant professor; 1910–1914, associate professor; 1914–1920, professor of railroad engineering; 1920–1928, professor of railway and highway engineering; 1928–1941, professor of railway and highway transportation; and 1941–1946, professor of civil engineering. In July 1946, he became professor of civil engineering, emeritus. Professor Breed served as head of the department of civil and sanitary engineering from 1933 to 1944, and as chairman of the faculty from 1940 to 1942. During World War I, he was president of the Academic Board of U.S. Army School of Military Aeronautics at M.I.T.

Professor Breed is co-author, with Prof. George L. Hosmer, of a two-volume text on *Principles and Practice of Surveying* that has been standard text in engineering colleges for over 40 years. He is author of a short text on surveying, and in 1944 wrote *Surveying Manual, EM 908*, for instruction use for the Armed Forces Institute in World War II. He acted as associate editor of the American Civil Engineers Pocketbook and of the American Mining Engineers *Handbook*. Professor Breed is also responsible for portions of several other technical books and many technical reports on economics of transportation in the railroad, highway and air transportation fields.

Coincidently with his entire teaching career, Professor Breed carried on the practice of his profession as consultant for railroads, municipalities, state departments, and on private projects. He joined with H. K. Barrows, M. ASCE, in 1909 to found the Boston consulting firm of Barrows & Breed. Since 1916 he has been in private consulting practice. His major activities have been consultant on elimination of grade crossings for several cities; consultant to several state public utility commissions on problems pertaining to elimination of grade crossings; valuations, bridges, traffic control, pavement design and performance; and consultant to the Association of American Railroads, the Pennsylvania, New York Central, Railway Association of Canada, and others. Professor Breed has also served the Massachusetts Department of Public Works on an investigation of pavement faults on the Boston-Worcester Turnpike, and has been consultant on large recreational land developments, such as the Seignury Club in the Province of Quebec, a project of the Canadian Pacific Railway. He has acted as arbitrator under the statutes of several states on disputes growing out of engineering contracts.

Charles B. Breed, Hon. M. ASCE

A corporate member of ASCE since 1903, Professor Breed was Director from 1943 to 1945. He is past-president of the Boston Society of Civil Engineers and of the New England Railroad Club, and national honorary member of Chi Epsilon and honorary member of Tau Beta Pi. His other affiliations include the Engineering Institute of Canada, the American Road Builders Association, the American Railway Engineering Association, the Highway Research Board, the Association of University Professors, and the American Society for Engineering Education. He has also been active in Boston civic affairs.

Professor Breed is a professional registered engineer in the states of Rhode Island, New York, and Massachusetts, and in the National Bureau of Engineering Registration.

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WILLIAM P. CREAGER

William P. Creager, of Buffalo, N.Y., has devoted 49 years of active practice to the field of hydraulic engineering, including predominantly hydroelectric power developments and dams.

Born in Baltimore, Md., Mr. Creager received his degree of civil engineer from Rensselaer Polytechnic Institute in 1901. In that year he was appointed provincial supervisor for the Philippine Government, for which his most important work was to assist in the study of changing the course of the Tarlac River that had broken its bounds during a great flood. Returning to the United States in 1904, he took a position as designer on the New York State Barge Canal to work on the design of dams and locks.

In 1906 Mr. Creager joined the staff of the J. G. White Engineering Corp. in the capacity of designer. During his 16 years' association with that corporation, he was engaged in the design of a large number of dams and hydroelectric power developments throughout the United States and abroad. He held the position of engineer of hydraulic structures at the time of his resignation, in 1922, to become vice-president and chief engineer of the Power Corporation of New York and the Northern New York Utilities, in charge of design and construction of hydroelectric projects.

When the Niagara Hudson Power Corp. was formed in 1930 to take over these and other corporations, Mr. Creager was appointed consulting hydraulic engineer for the corporation. At the same time, he established a general consulting practice. Since 1930 he has acted as consulting engineer for 30 public utility corporations involving designs of about 40 dams and 20 hydroelectric plants, as well as valuations, rate cases, and maintenance problems.

Mr. Creager's consulting work for the U.S. Army Engineers involved about 50 flood control dams, as well as the St. Lawrence and other power projects. He has also been consultant for other federal agencies, including the Tennessee Valley Authority and the Office of Production

Management, and for several state and city authorities, districts, and commissions. His field of consulting work has also included expert testimony on many litigations. In his years in practice he has been concerned with dam, hydroelectric, and water supply projects, valuations and reports, in 35 states and ten foreign countries.

William P. Creager, Hon. M. ASCE

Mr. Creager is author and co-author of books that have been extensively used as texts in this country and abroad. These include *Masonry Dams*, a treatise on design which was written in 1917 and rewritten and enlarged in 1928; *Hydroelectric Handbook*, written with Joel D. Justin in 1927, and revised and enlarged in 1949; and *Engineering for Dams*, written with Joel D. Justin and Julian Hinds in 1945. He has also contributed chapters on hydraulics, dams, and power for several other standard handbooks and encyclopedias, and numerous articles to engineering periodicals.

A member of ASCE for 36 years, Mr. Creager has been chairman of the Executive Committee of its Power Division, member of the Executive Committee of its Soil Mechanics and Foundations Division, and chairman or member of a number of other committees. He also belongs to the American Institute of Consulting Engineers and other national technical societies.

An advisory member of the United States Committee of the International Commission on Large Dams, Mr. Creager was reporter for its Second Congress in Washington and has been appointed recorder for its forthcoming Fourth Congress in India. He is a technical contributor to the Fourth World Power Conference, to be held in England in 1950, and a member of the United States Committee of the Second International Congress on Soil Mechanics and Foundation Engineering. He was a member of Task No. 5 Committee on allocation of power to postwar Germany.

Mr. Creager is a retired lieutenant colonel, and during the recent war he was a member of the Buffalo War Council and Deputy Commander of Civilian Defense for the city. He has been a trustee of Rensselaer Polytechnic Institute and a member of the Advisory Council for Princeton University, and is a member of Sigma Xi.

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WILFORD W. DEBERARD

A HALF CENTURY of service in the engineering profession is the enviable record of Wilford Willis DeBerard, city engineer of Chicago. He attended Beloit College (Wisconsin) and Massachusetts Institute of Technology, graduating from the latter in 1901. His first experience in the field of water supply and purification, which continues as his major interest, was in the three-year period between graduation from Beloit and resumption of his engineering education at M.I.T., when he served as chemist and bacteriologist for the Denver Water Co. Following his graduation from M.I.T., he spent several years in experimentation on the preliminary treatment of water and in design and construction of filtration plants for engineers and municipalities in various parts of the country.

In 1910, Mr. DeBerard began his association with *Engineering Record*, later *Engineering News-Record*, that extended to 1941, except for two short periods when he was granted leaves of absence to act as chief engineer for the Chicago Regional Planning Association (1926–1927), and as a member of the Sanitary District of Chicago Engineering Board of Review (1928). During his long service as Western editor, Mr. DeBerard contributed a continuous line of articles and editorials on engineering projects in the Middle West. Probably the most outstanding of these was a series of ten articles written after the disastrous Mississippi River flood of 1927. These articles discussed the engineering and economic aspects of flood control for the lower Mississippi Valley and were the first to suggest, in print, the possibility of cutoffs in the lower river as a method of flood relief.

During the period Mr. DeBerard served as chief engineer of the Chicago Regional Planning Association, studies were made for an extensive network of superhighways in the Chicago area, and rights-of-way were obtained for many of them. Standards for underground street structures were set up by the association and accepted by many of the suburbs in the area.

Since 1941, when Mr. DeBerard became city engineer of Chicago, he has been particularly active in improvement of

Wilford W. DeBerard, Hon. M. ASCE

the city's water supply and distribution and in the modernization of its bridge facilities. During this period, the South District Filtration Plant, costing $26,000,000 was completed and put in operation. This plant, the largest of its type, serves the southern third of the city. Plans for a 950-mgd plant, which will serve the remainder of the city and many of its suburbs, are now being prepared under Mr. DeBerard's direction. During his nine years as city engineer, he has also supervised construction of three major bridges, and has directed improvements in the water-distribution system that have greatly reduced leakage and waste.

An associate member of ASCE since 1906 and a full member since 1926, Mr. DeBerard served as a Director from 1938–1940, and as president of the Illinois Section in 1933. He has been secretary and chairman of the City Planning Division, chairman of the Waterways Division, member of the Committee on Engineering Economics and of the Membership Qualifications Committee, and chairman of the Professional Objectives Committee. He has just completed three years on the Washington Award Committee.

Mr. DeBerard is a life member of the Western Society of Engineers, which he has served as director and first vice-president and in numerous committee capacities, and an honorary member of the American Water Works Association. He was one of the founders of the Federation of Sewage Works Associations and has been its treasurer since its inception. His other affiliations include the Central States Sewage Works Association, the American Association of Engineers, the American Society of Sanitary Engineering, the American Road Builders Association, Phi Kappa Psi, and Theta Delta Chi. He holds life membership in the Chicago Engineers' Club, which he served as director from 1935–1937.

THEODORE VON KÁRMÁN

In forty years of scientific activity, Dr. Theodore von Kármán has made notable contributions to fluid mechanics, aerodynamics, and the theory of elasticity and structures. Born in Budapest, Hungary~~, he~~ graduated as a mechanical engineer from the Royal Institute of Technology in Budapest in 1902. Later he studied at the Universities of Goettingen, Paris, and London, receiving his Ph.D. at Goettingen in 1908. In 1909 he became lecturer at the same university, and in 1912 was appointed professor of mechanics and director of the newly installed Institute for Aeronautics at the Technical University of Aachen, Germany. After service in the first war in the Air Corps of the Austro-Hungarian Army, ~~he~~ returned to Aachen for research work.

Theodore von Kármán, Hon. M. ASCE

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Dr. von Kármán first came to this country in 1926 at the invitation of the Guggenheim Foundation for promoting aeronautical science. In 1928 he became research associate of the California Institute of Technology, and in 1930 was appointed director of the Guggenheim Aeronautical Laboratory at the same Institute, holding this position until 1949. As director of the laboratory, Dr. von Kármán initiated and directed a number of industrial research projects, including development of pumping equipment for the Metropolitan Water District of Los Angeles and the Grand Coulee Project (with Profs. R. L. Dougherty and R. T. Knapp). In 1941 he was appointed to the board that investigated the causes of the Tacoma Narrows Bridge failure. A year later, with co-workers and friends, he founded the Aerojet Engineering Corp., which was the first American firm specifically engaged in rocket development.

Dr. von Kármán has served the Armed Services in many capacities, and has been a member of the Scientific Advisory Committee for the Ballistics Laboratory at Aberdeen, Md., since its inception. At his suggestion the supersonic wind tunnel at Aberdeen was built, and he directed model tunnel studies at the Guggenheim Laboratory that formed the basis for design of that tunnel. Invited in 1944 to recommend a long-range research development program for the Air Forces, Dr. von Kármán formed a Scientific Advisory Group to the Commanding General of the Air Forces, which later followed the troops into Germany, under his leadership, and obtained early information on German technological developments. It was through Dr. von Kármán's efforts that the Air Documents Center was established—first in London and then at the Wright-Patterson Air Force Base. For these and other services for the Air Forces, he was awarded the Medal for Merit in January 1946. In the same year the Scientific Advisory Group was reorganized into a permanent advisory board, with Dr. von Kármán ~~as~~ chairman.

His contributions to fluid mechanics and aerodynamics include development of the theory of drag produced by vortex formation and, the theory of boundary layers and turbulence and numerous investigations into the statistical theory of turbulence and supersonic aerodynamics. Best known among his contributions to elasticity and structures are the so-called Engesser-Kármán theory of buckling beyond the elastic limit, the first theory of the deformation of curved pipes, and the non-linear theory of the stability of thin-walled shells (developed with H. S. Tsien).

Author with M. A. Biot of a widely used and translated text on mathematical methods for engineers, Dr. von Kármán has also written about 120 scientific papers, contributed to scientific handbooks, and has lectured before learned groups here and in London. He holds honorary doctorates in engineering from the Technical University, Berlin, Princeton University, and the University of Liege, Belgium; in science from the University of Brussels and the University in Aix-Marseille; and law from the University of California. Other honors accorded Dr. von Kármán include the ASME Gold Medal; the Sylvanus Reed Award of the Institute of Aeronautical Sciences; the John Fritz Medal; and the Franklin Medal. He is also Officier of the French Legion of Honor.

In 1948 Dr. von Kármán was named honorary professor of mechanical engineering at Columbia University. At present he also is chief scientific adviser to the Air Engineering Development Center, USAF, and chief technical consultant to the Aerojet Engineering Corp.

Dr. von Kármán's affiliations, in addition to ASCE which he joined as full member in 1932, include the Royal Society of London; the Academia dei Lincei, Rome; the ASME; the National Academy of Sciences, Washington; and academies of science in Paris, Torino, Italy, and Madrid. He is an honorary fellow of the Royal Aeronautical Society, England, and of the Institute of Aeronautical Sciences, and honorary member of the Franklin Institute, the French Society of Civil Engineers, and other organizations here and abroad.

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WILBUR M. WILSON

Wilbur M. Wilson, research professor of structural engineering emeritus at the University of Illinois, has made distinguished contributions to the field of structural engineering. A graduate of Iowa State College in 1900, with the degree of bachelor of mechanical engineering, he received the degree of master of mechanical engineering from Cornell University in 1904. Iowa State College conferred on him the professional degree of civil engineer in 1914 and the honorary degree of doctor of engineering in 1942.

For most of the period 1901 to 1907 he was on the mechanical engineering staff at Iowa State, successively as instructor, assistant professor, and associate professor. During the school year 1903–1904 he held a graduate fellowship in Sibley College, Cornell University. He practiced structural engineering in Chicago from 1907 to 1913—first as a structural detailer in connection with mill buildings and later as a designer of steel bridges. He then became assistant professor of structural engineering at the University of Illinois, resigning in 1917 to enter training camp as an officer candidate. After World War I, he returned to the university as associate professor of structural engineering. Beginning in 1922, he held the position of research professor of structural engineering until August 31, 1949, when he was made professor emeritus.

Professor Wilson belongs to a number of engineering societies, and is well known for his contributions to the literature of structural engineering. On two occasions, the Western Society of Engineers awarded him the Chanute Medal for the best paper of the year presented at its meetings. He also holds the J. James R. Croes Medal of the ASCE and the Wason Medal of the American Concrete Institute. He represented ASCE as a non-participating science observer at the atomic bomb tests at Bikini in 1946. In 1949 he received the Anson Marston Medal for "engineering achievement" from Iowa State College, and was appointed to the Comfort Adams Lectureship by the American Welding Society.

Widely known for his research work in the field of structural engineering, Professor Wilson did pioneer work in applications of the slope-deflection method to the analysis of statically indeterminate structures. In more recent years, his work has been largely experimental, and he has specialized in the testing of structures and structural members as distinguished from tests to determine the mechanical properties of materials. This work has contributed to professional knowledge of the design of rolling bascule bridges, cylindrical shells loaded as columns, multiple-span reinforced concrete arch bridges, and riveted and welded joints in steel structures.

Wilbur M. Wilson, Hon. M. ASCE

During the past decade Professor Wilson has devoted much of his time to determining the fatigue strength of structural members subjected to repetitions and reversals of load. Realizing that fatigue-strength values determined for carefully machined specimens were not applicable to fabricated structural members with severe stress raisers, he conceived the idea of developing fatigue machines with a capacity sufficient to test fabricated structural members. His success in developing a fatigue-testing machine of this capacity opened up a whole new field of experimentation, and has contributed much to present knowledge of the fatigue strength of both riveted and welded structural members. His work has enabled engineers to determine the locations where fatigue cracks are most likely to occur in old bridges and to detect them before they endanger the life of the bridge. As a specific indication of the importance of his research, early detection of more than 200 fatigue cracks in steel railway bridges in the past few years has permitted repair or replacement of the affected parts before complete failure occurred.

A corporate member of ASCE since 1922, Professor Wilson served as Director from 1944 to 1947.

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Proposed Constitutional Amendments to Be Discussed at Annual Meeting

Included in the order of business at the ASCE Annual Meeting in New York on Wednesday morning, January 18, will be discussion of the proposed amendments to the Constitution, which were submitted to the Local Sections for study several months ago, and to each member by mail on December 1.

The proposed amendments may be further amended in any manner consistent with the original by majority vote of members in attendance at the Wednesday morning meeting. As finally approved by the meeting, the amendments will then be sent to the membership for vote by letter ballot.

Revision of the Constitution has been under consideration by a Special Committee on Constitution and By-Laws for two years, and the form in which it has been submitted to the membership, was approved by the Board of Direction at its meeting on July 12, 1949.

An article giving the background of the proposed revision by Arthur W. Harrington, chairman of the Special Committee on Constitution and By-Laws, appeared in the November issue (page 59).

◆

B. A. Bakhmeteff to Head Engineering Foundation

Boris A. Bakhmeteff, Hon. M. ASCE, consulting engineer and professor of civil engineering at Columbia University, was elected chairman of the Engineering Foundation at its recent annual meeting in New York City. Dr. C. G. Suits, of the General Electric Co., was chosen vice-chairman. Reelected officers include Frank T. Sisco as technical director, and John H. R. Arms as secretary.

Dr. Bakhmeteff was also appointed chairman of the executive committee. Other members of the executive committee are Mr. Arms as secretary; Dr. Suits; Dr. A. B. Kinzel, vice-president of the Union Carbide and Carbon Research Laboratories, Inc.; Herman Weisberg, mechanical engineer in the Electrical Engineering Department of the Public Service Co. of New Jersey; and D. A. Quarles, vice-president of the Bell Telephone Laboratories, Inc.

Reports were made at the meeting on 14 research projects sponsored and supported in part by Engineering Foundation during the past year. These projects involve research in such varied fields as the properties of riveted and bolted structures for bridges, properties of steel at various temperatures, properties of reinforced concrete for building construction, welding, and lubrication. Grants were recommended for the year 1949-1950 for the continuation of ten of the past year's 14 projects and for the support of five new projects. Important new research will include the internal rusting of water pipes, the performance of power plant furnaces, and increased efficiency in building small homes.

The Research Procedure Committee will again be headed by Dr. Bakhmeteff.

◆

United Engineering Trustees Elects Officers

Edward C. Meagher, treasurer of the Texas Gulf Sulphur Co., New York, was reelected president of the United Engineering Trustees, Inc., at its recent annual meeting in New York. Also reelected were Irving V. A. Huie, M. ASCE, president of the Board of Water Supply, New York, and James F. Fairman, vice-president of the Consolidated Edison Co., of New York, as vice-presidents; Kurt W. Jappe, treasurer of the ASME, as treasurer; James L. Head, Department of Mines, Chile Exploration Co., New York, as assistant treasurer; and John H. R. Arms, as secretary.

ASCE Executive Secretary William N. Carey will head the Real Estate Committee, which includes James L. Head, Warner Seely, secretary of the Warner & Swasey Co., Cleveland, Ohio, and A. G. Oehler, editor, Simmons-Boardman Publishing Corp.

The chairman of the Finance Committee will be George W. Burpee, M. ASCE, New York consultant. Other members of the committee are R. F. Gagg, president, Air Associates, Inc., Teterboro, N.J.; D. A. Quarles, vice-president, Bell Telephone Laboratories, Inc., New York; and Mr. Jappe and Mr. Head.

UET is a corporation set up jointly by the four Founder Societies to promote "the advancement of the engineering arts and sciences in all their branches, the Engineering Foundation and the Engineering Societies Library." The corporation is the titular owner of the Engineering Societies Building and of the trust funds of the Library, the Foundation, the John Fritz Medal Board of Award, and the Daniel Guggenheim Medal Board of Award.

"Proceedings" Papers Become Separates

Number to Be Increased and Made Available on Request

A new procedure for publishing and distributing Proceedings papers goes into effect with the new year. This was decided at the 1949 Fall Meeting of the Board of Direction at Washington, D.C., when the Board approved a final report submitted by a special study committee. The new procedure is expected to increase materially the output of technical papers published by the Society, with little increase in total cost.

The Technical Divisions of the Society will assume greater responsibilities for the selection and pre-editing of papers. Beginning in February, all Proceedings papers will be issued as "Separates" and will be mailed on request through the use of a coupon carried in Civil Engineering. Automatic mailing of every paper and discussion to all members, will be discontinued.

Concluding its two years' study of all phases of the problem of giving "members the quality and quantity of technical papers they desire but by a less costly method than the present" and of "determining whether the present forms of preparation and distribution can be improved," the special Committee on Technical Publications, Procedures and Costs reported its conclusions and the Board approved the recommendations shown in the box on this page.

The final report of the special Committee on Technical Publications, Procedures and Costs, abstracted here, explains the new plan and the reasons behind its recommendations. Since its appointment in October 14, 1947, "the committee has made progress reports from time to time, and two matters—publication of memoirs and charges for Manuals—have been disposed of by eliminating the former from Transactions and adopting a policy of fixing a compensatory charge for Manuals."

In October 1948 the Board authorized the Committee to submit questionnaires to 1,000 members of the Society (including Juniors), "widely distributed geographically and selected by virtue of demonstrated interest in the Society's affairs." Similar questionnaires were submitted to Local Sections.

Questionnaires Favor "Separates"

Responses to both of these questionnaires and other investigations of the Committee indicated "that there was much dissatisfaction among the membership because of the small number of papers published, the aggravating delay between the time of submission of papers and their publication, and the relatively narrow range of subjects covered." Some members expressed a strong preference for the present form of Proceedings; others felt that the Society has a duty to send technical papers to all members whether the papers are read or not, and without a subscription price for Proceedings. A majority opinion favored publication of individual papers as "Separates."

Recommendations Adopted

1. That during the fiscal year 1950 and as early in the year as practicable, the form of "Proceedings" be changed to publication and distribution of individual papers as "Separates."

2. That the aim be to publish eventually no fewer than 100 "Proceedings" papers each year and the volume be built up to that number as promptly as may be done in an orderly manner.

3. That the Publications Committee prepare a Manual governing the practices of presentation and publication of papers and discussions and place in effect the provisions of such Manual; that the Manual specify that papers on the average be kept within a compass of 20 pages and discussions, 10 pages. Exceptions can be granted for papers of exceptional merit.

4. That papers to be published be selected by the respective Technical Divisions and be pre-edited by them, in accordance with the principles to be set forth in the Manual.

5. That "Proceedings" papers intended to be presented orally be prepared in ample time to permit distribution in advance of presentation.

6. That there be printed in "Civil Engineering" a preview of each paper in sufficient detail to enable a member to appraise its scope and character, and a detachable form for handy use in ordering papers.

7. That each member be entitled, on request, to obtain each year, without charge, any 25 papers that he selects.

8. That the charges to members for papers in excess of 25 a year be 25 cents for the average paper with correspondingly higher charges for exceptionally long papers. Papers so ordered shall be furnished at those rates until the printed stock of each has been exhausted.

9. That the charges to non-members for individual papers be 50 cents for the average paper; annual subscription rates, for all papers published during the year, to libraries, educational institutions, or individuals be fixed by the Board.

10. That the papers and discussions be assembled and published in "Transactions" which, as now, will be sold to subscribers at a price per volume to be fixed by the Board.

11. That the Publications Committee and the Executive Secretary be authorized to take prompt steps to initiate the procedures above recommended.

After estimating the cost of printing and distributing Proceedings as "Separates," the Committee reported its conclusion that adoption of that procedure "would permit great expansion in the number of technical papers at no greater cost than the present method." It emphasized its conviction that the keystone of this procedure would be the cooperation by Technical Divisions in selecting and pre-editing papers. At the request of the Board the special Committee met with the Technical Procedure Committee for two days in August 1949, to discuss the plan and to determine the extent that Technical Division cooperation could be counted on. Division representatives agreed to undertake the selection and pre-editing of papers in accordance with a technique to be worked out jointly by the Committee on Publications and TPC.

According to the report, pre-editing is the critical review of a paper to determine the features most worthy of emphasis, material which can be abbreviated or eliminated with advantage to the paper, and the points where the presentation may be improved. Re-editing is to be done by the author to the satisfaction of the Technical Division concerned. This procedure will relieve the editorial staff of technical publications of a great mass of detailed editing and at the same time increase the output of papers with nominal increase of staff.

Automatic Distribution by Categories Rejected

On Board instruction, the special Committee reviewed its proposals in detail at a meeting with the Committee on Publications in June 1949. One of the proposals presented by the Committe on Publications for further consideration was a plan dividing the Proceedings papers into four categories, each containing papers of interest to one or more of the Technical Divisions. This plan also included set mailing lists, to which the categories of papers would be mailed automatically. Technical Divisions would be divided into four groups, the grouping being made as nearly as practicable on the basis of mutual interest and equal distribution of papers.

Cost excluded, the basic difference between the category plan and that for straight "Separates" is the automatic mailing of papers. To the special Committee the establishment of groups of Technical Divisions for determining the automatic mailing lists appeared unduly restrictive. In the accompanying tabulation, Table III of the report, the special Committee compares the annual costs of carrying out the "Separates"

TABLE III. Comparative Estimate of First Year's Cost to Distribute 100 "Proceedings" Papers (20 pages each) and Discussions (10 pages each)

	SEPARATES	FOUR GROUP	PRESENT
A. Items which are not common to all plans:			
Paper	$ 750	$ 6,000	$ 24,500
Printing	3,000*	7,900†	29,000
CIVIL ENGINEERING coverage	780		
Mailing and postage	9,000	3,100	11,000
Plant and equipment	1,400	2,600	500
Sub-totals	$14,930	$19,600	$ 65,000
B. Items common to all plans:			
Composition and illustrations	$40,500	$40,500	$ 40,500
Office payroll	30,000	30,000	30,000
Division expenses (estimated $250 per division per year)	3,300	3,300	3,300
Totals	$88,730	$93,400	$138,800‡

* 2,500,000 pages.

† 19,500,000 pages.

‡ The number of "Proceedings" papers published during 1947 was 32. During 1948 the output was 46 papers. The average number of papers published during the five years 1943 to 1947, both inclusive, was 38. Largely because of the customary length of discussions, the average total number of pages for "Proceedings" papers for 1947 and 1948 is 1,422.

plan with a Four Group (categories) Plan and the Present System.

The only way to make more papers available to all members, without material increase in cost, is to make substantial reduction in paper and press work, and by obtaining editorial and other assistance from the Technical Divisions. The report concludes that it would be impractical to work out any grouping of papers likely to satisfy all members of the thirteen Technical Divisions, and that the economy inherent in the categories plan as compared with present publishing procedure is less favorable than the possibilities in the more flexible plan of "Separates."

The publication procedures of many societies were studied including a study of the experience of ASME and AIEE with their present "Separates" procedure. After the Committee submitted its final report and the Board actions recorded here were taken, the Committee was discharged with the thanks of the Board. The special Committee was composed of George W. Burpee, chairman, W. N. Carey, Roy Crum, Shortridge Hardesty, H. W. Richardson, and Stanton Walker. Full cooperation throughout the study was furnished by the Society's Committee on Publications, of which Shortridge Hardesty was chairman in 1948 and Roy Crum in 1949.

Further discussion of the Committee's report and information on the operation of the new plan will be published in subsequent issues. On another page of this issue will be found the first list of abstracts of PROCEEDINGS "Separates" to be available upon request by members who return the order form provided.

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C. E. Publisher Honored for Aid to Technical Printing

HARVEY F. MACK, FOUNDER and head of the Mack Printing Co., at Easton, Pa., which has handled the printing of CIVIL ENGINEERING since its inception almost 20 years ago, was recently honored by Lafayette College with the honorary degree of doctor of humane letters for his contributions to the field of scientific and technical printing.

The citation accompanying Mr. Mack's award honors him for his creation of "the means of publication of scientific data, the recording of the products of research, and the dissemination of scientific discoveries and ideas among the scholars and scientists of the nation." It concludes, "Your discerning perception of that need, your courageous devotion to a great educational task, your achievement of an organization publishing so many of the scientific journals and books of America is a major contribution to the science and education of America and the world. Society is indebted to you."

HARVEY F. MACK, printer of "Civil Engineering," receives honorary degree of doctor of humane letters from Lafayette College for his contributions to field of technical publishing.

A pioneer in technical publishing, Mr. Mack entered the field fifty years ago when scientific and technical literature was available chiefly in book form at a cost beyond the reach of the average person. He has built up the company now bearing his name from a tiny organization with a staff of 22 to a complete publishing service, employing 525. In addition to CIVIL ENGINEERING, the Mack Printing Co. prints more than fifty technical periodicals, various technical society proceedings, technical bulletins and catalogs, and more than fifty scientific books annually.

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G. H. Fenkell, Hon. M. and Former Director, Dies

ASCE HONORARY MEMBER and former Director George H. Fenkell died on November 8 at his farm at Almont, Mich., where he had lived since his retirement ten years ago as superintendent and general manager of the Detroit Water Board. He was 76, and an alumnus of the University of Michigan.

George H. Fenkell, 1873–1949

A specialist in problems of water supply, Mr. Fenkell was with the Erie, Pa., Commissioners of Water Works before becoming connected with the Detroit Water Department in 1908. He served as commissioner of public works for the city from 1913 to 1918, and from the latter year until his retirement in 1939 was superintendent and general manager of the Department of Water Supply. Mr. Fenkell also served for two years on the Board of Review for the Sanitary District of Chicago, and had been a consultant on various projects.

A corporate member of ASCE since 1902, Mr. Fenkell was elected Honorary Member in 1940. He was Norman Medalist in 1902, and served a term as Director from 1923 to 1925. He was also honorary member and past-president of the American Water Works Association and of the Michigan Engineering Society; past-president of the Detroit Engineering Society; and a member of Tau Beta Pi.

PROCEEDINGS PAPERS
AVAILABLE AS SEPARATES

THE FOLLOWING PAPERS, to be printed as Separates, are now subject to advance orders, based on the summaries here given. Discussion of these papers will be received as in the past. A summary of each paper will appear in three consecutive issues of CIVIL ENGINEERING, and papers will be mailed soon after returns give an indication of the number to be printed. Abstracts of other papers will be added every month to the list of Separates available. Information concerning distribution to members is noted on the mail order coupon (p. 107).

1. **Improvements at the Back River Sewage Works, Baltimore, Md.**, by C. E. Keefer, M. ASCE. Both increase of load and decrease of relative efficiency combined to require expenditures of almost $4,000,000 in improving primary and secondary treatment for the city and its environs. Included in the improvements were screens, grit chambers, settling tanks, activated sludge units, chlorination, digestion tanks, gas holder and vacuum filters. Other accessories, as pumps, pipelines, and power station, helped in this modernization completed in 1947.

2. **Public Utility Condemnation Cases in the State of Washington** by Henry L. Gray, M. ASCE. This simple narration deals with the Washington Public Utility Act and its workings, and particularly the acquisition of a number of privately owned light and power properties through 19 condemnation proceedings, all heard in Courts. Many important data are given, also certain conclusions as to what might be expected to happen in such cases, with suggestions and advice as to engineering procedure in condemnation matters.

3. **Treatment of Foundations of Large Dams by Grouting Methods** by A. W. Simonds, M. ASCE, Fred H. Lippold, M. ASCE, and R. E. Klein, Assoc. M. ASCE. Nowadays large dams require foundation treatment, the success of which is only determined after the structure is in operation. General plans for the successful treatment by pressure grouting as developed in a score of structures completed since 1935 by the Bureau of Reclamation and the TVA include low-, intermediate-, and high-pressure grouting in specific areas beneath the base. Various grouting materials, methods, and types of equipment are discussed, their advantages and disadvantages being shown under varying conditions and at different locations.

4. **Capillary Phenomena in Cohesionless Soils** by T. William Lambe, Jun. ASCE. Fundamentals of capillarity in cohesionless soils are explained by first describing analogies in capillary tubes and then presenting data from soil tests to substantiate the conclusions. Presently used theoretical methods for computing the rate of flow of water under the influence of capillarity are investigated and evaluated, and improvements are suggested. The paper also discusses the limiting values of capillary head which a cohesionless soil may have, and the role of the different capillary heads in the various types of capillary flow.

5. **Elastic Restraint Equations for Semi-Rigid Connections** by J. E. Lothers, M. ASCE. Most beam-column connections, through the outstanding legs of structural shapes, are styled "semi-rigid framing." Deflection of these legs gives rise to a rigidity intermediate between those of simple and "rigid frame" connections. Recent laboratory measurements in this country and England have disclosed a constant, Z, which is needed for the analysis of such connections. Equations here derived for finding Z for the web-angle type obviate the necessity for expensive laboratory measurements.

Order coupon on page 107.

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Centennial Celebration to Be Held in Chicago

PLANS FOR APPROPRIATE observance of the Society's centennial anniversary are taking shape. The celebration, scheduled to be held in Chicago during the period September 5 to 13, 1952, inclusive, will include a broad technical program, on a national and international scale, and an engineering exposition at Soldiers Field.

With approval of its program by the Board of Direction at the Fall Meeting, the Society's Centennial Celebration Committee has gone into action under the leadership of Past-President Malcolm Pirnie as chairman. Former Director Irving V. A. Huie is serving as chairman of an Executive Committee to develop an adequate organization and get the program under way.

Other engineering societies and allied organizations will be invited to participate in the celebration, with the objective of placing before the world, on a scale never before undertaken, a pageant portraying developments in engineering during the past century.

Such an ambitious program will demand the best efforts of large numbers of the Society's members all over the country, through participiation in committee work and otherwise.

Members are urged to look under the heading "1952 Centennial Celebration" in subsequent issues of CIVIL ENGINEERING so that they may keep abreast of the situation and be prepared to contribute their best efforts toward the success of this unique and memorable occasion.

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Revised Code of Ethics Is Ready for Framing

COPIES OF THE ASCE Code of Ethics, as revised by the Board of Direction at its Fall Meeting (December issue, pages 52 and 61), may be obtained from Society headquarters without charge. The revised code is $8\frac{1}{2} \times 11$ in. in a form suitable for framing. To facilitate ordering, a special blank is provided on page 86. A reduced facsimile of the revised code is shown here.

American Society of Civil Engineers

Code of Ethics

It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

◆

Council on Reinforced Concrete Research Meets

THE COUNCIL ON Research in Reinforced Concrete, which was formed last year by the Engineering Foundation to conduct research projects in reinforced concrete "considered necessary to place methods of design on a more rational basis," recently held its first meeting in Chicago. Plans were discussed for the future work of the Council, and a report on a project now under way at the University of Illinois was received. The latter program involves testing 120 reinforced concrete columns under varying eccentricities of load. Strains will be measured and the analysis will attempt to correlate the results with existing proposed ultimate theories for concrete.

Chairman of the Council is Robert F. Blanks, M. ASCE, director of research for the Bureau of Reclamation.

NOTES FROM THE *Capital*

Joseph H. Ehlers, M. ASCE
Field Representative, ASCE

IN THIS LULL between storms with no legislative action to report and few moves in the executive departments requiring notice by the profession, it seems appropriate to use this column to discuss the operations of the Washington office and some of the activities of the Field Representative in fulfilling the purposes for which the office was established.

The principal function of the office is to serve as an observation post—to know what legislative and other actions affecting engineers are impending here and to keep the Board of Direction informed. ASCE appears in legislative matters largely through panels of appointed members who are specialists in particular fields. Its staff serves primarily to prepare the background facts and to make preliminary contacts.

Congress respects and values the opinions of the engineering profession because they are reasoned and moderate and relate to matters on which the members of Congress are not ordinarily well informed. The Society takes a position on legislative questions when they are of importance and of direct concern to engineers. No position ever is taken until after the public interest aspect has been considered carefully. The Society is not self-seeking. On that basis we have the respect of members of Congress and our views are often sought on matters of technology, on the economics of engineering and public works, and on technical management problems.

The administration of an Act is often as important as the terms of the legislation itself. Many matters of prime interest to engineers are covered by administrative regulations rather than legislative acts. Actually this office has occasion to deal oftener with administrative departments than with the legislative branch. It is in constant touch with General Services, Defense, State, Commerce, Interior, Housing and Home Finance Agency, Civil Service Commission, and other agencies.

The Field Representative serves on various committees to draft reports on public works, to revise government contract forms, to revise fee schedules for engineers, to discuss qualifications for engineering positions, and to advise on technical details of concern to various agencies. Such non-governmental units as the Natural Resources Council have invited the office to be represented at sessions relating to engineering.

The over-all segment of our economy designated the "Construction Industry" is represented by many organizations in which ASCE members and officers take an important part. Our members serve on important committees in such groups as the Construction and Civic Development Department of the Chamber of Commerce of the United States; assisted by the Washington office. This office is in close contact with construction industry efforts involving coordination between the associations representing general business, architects, contractors, manufacturers, sub-contractors, bankers, municipal and state officials, all of whom are represented in Washington and most of whom have their principal offices here.

Foreign embassies use the Washington office for information on Society activities, on engineering questions, and on engineering personnel for foreign service.

The engineering profession has an important service to render in national affairs and is prepared to assume leadership in national and international developments in its own immediate field.

The National Engineers Committee of Engineers Joint Council, stands ready to serve and assist government bureaus whenever engineering experience and talents within the scope of the committee may be helpful. The committee is at present under ASCE chairmanship with all EJC Societies represented. This permits problems to be considered from the broad viewpoint of all the profession, as well as from the specialized viewpoint of the members of the Society most intimately connected with a particular problem. The Committee maintains contact with various government agencies through the Washington office of ASCE. It has a Washington contact subcommittee on which the Field Representative serves.

When the Field Representative, located in Washington, D.C., has time to spare from Washington business, he is expected to make visits to Local Sections and Student Chapters in the interest of the Society. Circumstances have prevented much of this travel during 1949, but it is hoped that more such visits will be possible during 1950.

Washington, D.C.
December 20, 1949

NEWS OF LOCAL SECTIONS

Coming Events

Central Ohio—Meeting at the Chittenden Hotel, Columbus, Ohio, January 19, at 6:15 p.m.

Colorado—Dinner meeting the second Monday of every month at 6:30 p.m.; technical meeting at 8 p.m. Section luncheon every Wednesday at Daniels & Fishers Department Store at 12 noon. The Soil Mechanics and Foundations, Hydraulics, Structural, and Irrigation Divisions of the Section meet monthly on the first Monday, the first Tuesday, the third Thursday, and the fourth Monday, respectively.

Duluth—Meeting at the Kitchi Gammi Club, Duluth, January 16, at 12:15 p.m.

Iowa—Meeting at the Iowa State College, Ames January 12, at 7:30 p.m. Dinner meeting in Yonnkers Tea Room, Des Moines, at 6:30 p.m.

Kansas—Meeting in Topeka on January 13.

Los Angeles—Annual meeting at the University of Southern California, Los Angeles, on January 11. A seminar with ASCE, ASME, and AIEE participating is to be held at the California Institute of Technology, Pasadena, January 18. The Sanitary Group of the Section is scheduling a meeting for the Clark Hotel, Los Angeles, January 25.

Louisiana—Meeting at the St. Charles Hotel, New Orleans, January 14, at 9 a.m. Another meeting will be held in the Army-Navy Club, New Orleans, January 28, at 7 p.m.

Maryland—Meeting in the Engineers Club of Baltimore, January 11; dinner at 7 p.m. and meeting at 8 p.m.

North Carolina—Annual meeting in the Y.M.C.A. Building, State College, Raleigh, January 14, at 10 a.m.

Northeastern—Annual meeting at Northeastern University, Boston, Mass., January 23.

Philadelphia—Meeting in the Engineers Club, Philadelphia, January 10, at 7:30 p.m.; preceded by dinner at 6 p.m.

Pittsburgh—The juniors of the Pittsburgh Section are sponsoring an inspection trip through the Frank R. Phillips Power Station of the Duquesne Light Co., January 14, at 10 a.m.

Sacramento—Regular luncheon meetings every Tuesday at the Elks Club, Sacramento, at 12:30 p.m.

Recent Activities

ARIZONA

THE ARIZONA SECTION took part in a recent two-day convention of all the engineering groups in the state, which was held in Phoenix. Included in the Section's technical program were papers on the design of the Queen Creek Bridge by Ralph Hoffman, state bridge engineer, and Warren Hunter, and J. A. Rau, engineers on the project; recent developments in sanitation by George W. Marx, director of the State Bureau of Sanitation; and engineering valuation by R. L. Blake, appraiser. Society President Franklin Thomas summarized ASCE aims and objectives in a panel of talks by representatives of all the engineering groups at a joint dinner meeting. Other societies participating in the program, the first of its kind to be held in the state, were local groups of the ASME, AIEE, and ASPE.

BUFFALO

HIGHLIGHTS OF THE Fall Meeting in Washington were reported by Section Vice President Harold I. Howell at a recent luncheon meeting. Mr. Howell also gave a short account of his trip to Russia as a consultant on tests of the generating equipment for the Dnieper Dam.

CENTRAL ILLINOIS

PRESENT-DAY LABOR RELATIONS and problems involved in maintaining labor peace in industry were detailed at a recent dinner meeting by Paul Musgrove, labor relations attorney for Hiram Walker & Sons, Inc. A discussion of the proposed changes in the ASCE Constitution was headed by J. W. Briscoe.

COLORADO

DESIGN OF THE Soap Lake Siphon, part of the Columbia Basin Project in Washington, was described by Robert Sailer, head of the Bridge Section of the Bureau of Reclamation, in the leading talk at a recent dinner meeting. Mr. Sailer's talk was originally given at the ASCE Fall Meeting in Washington. A. L. Ahlf presented a resume of the Local Section Conference held during the Washington meeting, which he attended as Section delegate.

CONNECTICUT

ASCE PARTICIPATION IN legislative affairs through the medium of Engineers Joint Council was described by President Franklin Thomas in a talk on the growth and development of the Society given at a recent dinner meeting in New Haven. Later President Thomas headed a lively discussion of the ASCE in various professional and social relationships.

DISTRICT OF COLUMBIA

Advantages of new designs in deformed bars for reinforcing steel were pointed out at the Section's annual meeting by O. W. Irwin, president of the Rail Steel Bar Association. Mr. Irwin supplemented his talk with a color film that traced the development of the steel industry. New Section officers, elected during the meeting, are Albert G. Fiedler, president; Charles J. Stevens, vice-president; Waldo E. Smith, secretary; and Daniel B. Ventres, treasurer. ASCE Vice-President Henry J. Sherman attended the meeting and presented certificates of life membership in the Society to 14 Section members.

GEORGIA

CURRENT RESEARCH PROJECTS at the Georgia Institute of Technology were described by Professors George Sowers and Melvin Jackson in an afternoon program of technical papers presented at the Section's annual meeting on December 10. Other speakers were Rennie V. Tye, chief petrographer of the South Atlantic Division of the Corps of Engineers, who discussed petrography as applied to civil engineering, and Harry B. Andrews, land agent for the City of Atlanta, who described problems involved in land acquisition for major improvements. At the dinner meeting that followed certificates of life membership were presented to William C. Cram, Jr., Word Leigh, and Ralph F. Rhodes. ASCE Director Edmund Friedman, of Miami, concluded the program with a talk on the importance of contracts between Local Section and Society officers. New Section officers are J. Moran Roberts, president; Moses E. Cox and Thomas H. Winchester, vice-presidents; and Charles M. Mower, Jr., secretary-treasurer.

Scheduled ASCE Meetings

ANNUAL MEETING

New York, N.Y., January 18–20
(Board of Direction meets
January 16–17)

SPRING MEETING

Los Angeles, Calif., April 26–29
(Board of Direction meets
April 24–25)

ANNUAL CONVENTION

Toronto, Canada, July 12–14
(Board of Direction meets
July 10–11)

FALL MEETING

Chicago, Ill., October 11–13
(Board of Direction meets
October 9–10)

INTERMOUNTAIN

ASCE DIRECTOR SIDNEY T. Harding, of Berkeley, Calif., summarized recent activities of the Board of Direction, commenting particularly on their effect on the Intermountain Section at a recent meeting. The technical program consisted of a talk on recreational development and use of the national forests by A. G. Nord, of the U.S. Forest Service. At another recent meeting the principal speaker was Russell Cameron, chemical engineer for the U.S. Bureau of Mines, who described the Bureau's oil shale operations at Rifle, Colo.

IOWA

STUDENT CHAPTER ACTIVITIES during the past year at Iowa State College and the University of Iowa were reviewed by the presidents of the two groups—Don Ratekin and C. D. Johnson—at a recent afternoon business meeting of the Iowa Section in Des Moines. Officers elected for 1950 are John Carpenter, president; C. J. Posey, vice-president; and L. O. Stewart, secretary-treasurer. At the dinner meeting that followed, a symposium on deep highway cuts in Harrison County, Iowa, was presented by Dr. C. S. Gwynne, of the Iowa State College Geology Department; John Butter, administration engineer for the Iowa Highway Commission; and M. G. Spangler, research associate professor in the civil engineering department at Iowa State.

LOS ANGELES

SILTING OF THE Colorado River both above and below Hoover Dam was discussed by Carl Vetter, chief of the Bureau of Reclamation's River Control Office at Boulder City, Nev., at a recent meeting of the Los Angeles Section. During the business session ASCE Director Julian Hinds presented a summary of Board actions at the Fall Meeting. Balloting for 1950 officers resulted as follows: R. R. Shoemaker, president; Paul Baumann, first vice-president; Linn Larson, second vice-president; and Ralph Durke, treasurer. Homer Jorgensen carries over as secretary for another year.

The Junior Forum had one of the best meetings of the year, with an attendance of 60. Juniors Bob Davis and Bud Carroll spoke on collective bargaining, as it pertains to engineers, and additional discussion was requested of Sterling Green because of his experience with West Coast professional employee groups.

MID-SOUTH

ASCE Vice-President Robert B. Brooks, of St. Louis, and Director Webster L. Benham, of Oklahoma City, attended the 20th annual meeting of the Mid-South Section in Memphis, December 8–10, and discussed Society affairs. New officers for 1950 are Herbert S. Gladfelter, Memphis, Tenn., president, and Harold J. Engstrom, Jr., Little Rock, Ark., vice-president. Haywood G. Dewey, Jr., of Jackson, Miss., was reelected permanent secretary-treasurer. The technical program, which occupied the better part of two days, included talks by Thomas H. Allen, president of the Memphis Light, Gas, and Water Division, who discussed the city's water supply, and Rear Admiral Leo O. Colbert, director of the U.S. Coast and Geodetic Survey, whose subject was "Maps—a Basic Tool for the Engineer." W. B. Fowler and O. F. Sorgenfrei briefed the group on the Memphis and Arkansas Bridge and the E. H. Crump Boulevard, objectives of an afternoon inspection trip. Social events included an "Early Birds' Reception" for those arriving Thursday evening, a joint luncheon with the Engineers Club of Memphis and an evening banquet on Friday. J. R. Newman was general chairman of the meeting.

In a talk, entitled "Engineering and Murder," presented at a recent meeting of the newly formed Jackson Branch of the Section, City Commissioner R. S. Withers, Jr., advocated adequate traffic lanes and separation as major remedies for the high rate of traffic fatalities on the highways. Commissioner Withers pointed out that no fatalities have occurred on the separated four-lane highway between Hattiesburg and Camp Shelby in the past two years, although the area is hilly and there is some curvature, in contrast to a straight, level 30-mile stretch with two-way traffic that has the highest fatality rate of any road in the state.

NORTH CAROLINA

The fall meeting of the North Carolina Section, held at Buggs Island Dam, Virginia, consisted of inspection of the aggregate plant and construction work, a business meeting, and luncheon. Numerous Society and Section matters were discussed during the business session, and J. McCree Smith reported on plans for increasing the civil engineering facilities at North Carolina State College. Attendance included 100 members of the North Carolina State College Student Chapter.

OKLAHOMA

Road-building problems in Oklahoma were discussed in the leading talk at a recent meeting by J. Rogers Martin, research engineer with the Oklahoma A. & M. Institute of Technology. Professor Martin made special reference to developments in the field of asphalt and asphaltic concrete pavements. ASCE Director Webster L. Benham reported on the summer and fall meetings of the Board.

1949 Index Available

MATERIAL APPEARING IN the twelve issues of "Civil Engineering" from January through December 1949, is included in the index to Volume 19, now available without charge on request to Society Headquarters for those desirous of incorporating it in their 1949 bound volumes. For convenience, an order blank is given on page 86 of the advertising department.

Single copies of the index are sent to all subscribing libraries. Extra copies are available on request.

PHILADELPHIA

A symposium on the Pennsylvania Turnpike and Philadelphia's connection with it and the Schuylkill Expressway comprised the program at the December 13 meeting of the Philadelphia Section. Speakers were Thomas Buckley, Philadelphia director of public works; Gerard B. Gilbert, engineer for the Pennsylvania Turnpike Commission; Edward L. Schmidt, chief engineer for the Pennsylvania Department of Highways; and Michael Rapuano, landscape architect. The Civic Development Bureau of the Philadelphia Chamber of Commerce was invited to attend the meeting.

Building a proposed $8,400,000 sewage disposal plant at Wilmington to rid the Delaware River of pollution was advocated by Gustave Requardt, Baltimore consultant, at a recent meeting of the recently formed Delaware Sub-Section. Calling the proposed project "a wonderful thing for the people of Delaware," Mr. Requardt said the new plant, to be erected near the junction of the Christina and Delaware rivers, would end the practice of feeding raw sewage into the Delaware from several tributaries.

TOTAL MEMBERSHIP AS OF DECEMBER 9, 1949

Members	7,481
Associate Members	9,635
Corporate Members	17,116
Honorary Members	40
Juniors	10,407
Affiliates	75
Fellows	1
Total	27,639
(December 9, 1948	24,748)

PITTSBURGH

The engineer's part in building construction was detailed at a recent joint meeting with the Civil Section of the Engineers Society of Western Pennsylvania by J. P. H. Perry, vice-president of the Turner Construction Co. At another recent joint meeting of the two groups G. B. Gilbert, safety engineer for the Pennsylvania Turnpike Commission, spoke on the eastern and western extensions of the Turnpike now under construction. The Pittsburgh parking problem and solutions proposed by the Pittsburgh Parking Authority constituted the topic of discussion at the December meeting, which was addressed by Donald McNeill, engineer coordinator for the Authority.

PROVIDENCE

Methods used in supporting building foundations on soft ground were outlined by Dr. Arthur Casagrande, Gordon McKay Professor of Soil Mechanics and Foundation Engineering at Harvard University, at the December meeting of the Section. To show applications of these methods Dr. Casagrande presented lantern slides depicting the foundation work done on the New England Mutual and John Hancock life insurance buildings in Boston and problems arising in foundation construction in Mexico City.

SACRAMENTO

In a talk on "Recreational Planning for Flood Control Projects," given at a recent Sacramento Section luncheon meeting, Everett M. Hallaver, landscape architect for the Sacramento District of the Corps of Engineers, emphasized the consideration being given recreational aspects of such Corps of Engineers projects as Isabelle Dam, Pine Flat Dam, and Folsom Dam. Other recent luncheon meeting speakers include Gordon A. Fleury, assemblyman, who described his experiences in the California Assembly, and Martin Blote, superintendent of the Central Valley Project, who discussed construction of the project.

SAN DIEGO

Design features of the Alvarado Treatment plant were described at a recent dinner meeting by J. M. Montgomery, Los Angeles consultant, who pointed out the necessity for designing a flexible plant that will treat water of markedly different characteristics, since both Colorado River and local water are received for treatment. Part of the meeting was devoted to business.

SEATTLE

Transportation and other engineering problems in Israel were described at a recent meeting of the Seattle Section by Col. Marmion D. Mills, who recently returned from the State of Israel, where he acted as consultant to the government on its transportation system. Colonel Mills stated that most of the highways and railroads in the country were destroyed during the war, and that rebuilding is progressing slowly. Upon the advice of the Section's Earthquake Study Committee, a motion was made and passed urging the University of Washington to offer courses in the seismic design of structures at its Adult Education Center in order to meet the threat of earthquake damage in the area.

TENNESSEE VALLEY

Basic problems involved in master planning the new city of Oak Ridge were discussed in the principal technical paper presented at the recent two-day fall meeting of the Tennessee Valley Section in Oak Ridge, Tenn., by John Merrill, of the Chicago firm of Skidmore, Owings & Merrill. Mr. Merrill is planning consultant for the Oak Ridge Master Plan. Later the group was taken on a tour of the areas in which construction is under way and heard Fred W. Ford, director of community affairs for the Atomic Energy Commission at Oak Ridge, speak on problems involved in operating a government-owned one-industry city. Other aspects of the atomic-energy program were discussed at the Friday evening dinner dance by R. W. Cook, manager of Oak Ridge Operations for the Atomic Energy Commission, who told the group of the work being done by civil engineers in building and operating AEC plants and laboratories. Guest speaker at the dinner was Dr. Edward McCrady, chief of the Biology Division of the AEC at Oak Ridge, who spoke on the topic, "Research in the Mechanism of Hearing."

TRI-CITY

Society plans and activities were outlined at the Section's annual meeting in Davenport, Iowa, by ASCE Director Samuel A. Greeley, of Chicago. New officers elected during the business session are Frank H. Beinhauer, president; Robert D. Schmickle, vice-president; and A. P. Rinell, secretary-treasurer. Prof. M. C. Boyer, of the State University of Iowa, addressed another recent Section meeting on the subject, "Pennsylvania Cleans Her Streams."

WISCONSIN

Following an annual custom started last year, Juniors of the Section presented the program at a recent meeting of the Wisconsin Section. Speaking in a symposium on "What Industry Offers to, and Expects of, the Young Civil Engineer," the Juniors presented the viewpoint of various professional fields. Construction and structural engineering were treated by R. C. Johnson, vice-president of Siesel Construction Co.; municipal engineering, by H. B. Wildschut, city engineer of Wauwatosa; highways, by W. P. Ward, secretary of the Wisconsin State Highway Commission; railroads, by F. M. Sloane, division engineer for the Milwaukee Road; and water power, by W. E. Schubert, vice-president of the Wisconsin-Michigan Power Co. William Grede was moderator of the symposium. The annual election of officers resulted as follows: F. M. Sloane, president; C. W. Yoder, first vice-president; Carl R. Holdampf, second vice-president; and Ralph H. Boeck, secretary-treasurer.

STUDENT CHAPTER Notes

UNIVERSITY OF MICHIGAN

ASCE President Franklin Thomas spoke on the aims and activities of the Society before Student Chapter members of Wayne University, Michigan State College, the University of Detroit, and the University of Michigan, at a meeting held on the University of Michigan campus in Ann Arbor. The showing of a film on the exploration of the Antarctic concluded the program.

MARQUETTE UNIVERSITY

Leaders in the railroad, municipal, structural and highway fields, took part in a recent panel discussion that endeavored to show Marquette University Student Chapter members "What Industry Has to Offer the Young Civil Engineer and What Is Expected of Him." The plant of the Johnson Wax Co., of Racine, Wis., where a research tower is under construction, was the objective of a recent inspection trip. New officers of the Chapter are Ed Mangotich, president; Bob Austin, vice-president; Dave Hanley, secretary; and Gene Zink, treasurer.

RENSSELAER POLYTECHNIC INSTITUTE

Activities and events of the Student Chapter Conference held during the Fall Meeting in Washington were reported at a recent meeting of the Rensselaer Polytechnic Institute Student Chapter by Burt Howe, Ronnie Coulter, and John McClure, official Chapter delegates to the Conference. The rest of the program consisted of the showing of a sound movie depicting construction of the historic Stilwell Road. At another recent meeting Frank F. Fifer, consultant to the North Atlantic Division of the Army Corps of Engineers, discussed the proposed St. Lawrence Seaway Project. Paul Bird, chief geologist of the State of New York, was principal speaker at another recent meeting. The Chapter has scheduled an ambitious program for the current year, including talks by Rear Admiral J. J. Manning, retiring head of the Bureau of Yards and Docks, and D. B. Steinman, New York consultant and bridge authority.

NEW YORK UNIVERSITY

Difficulties involved in designing a suitable ventilating system for the Holland Tunnel were discussed in a talk supplemented with slides by Dr. Ole Singstad, New York consultant, before a recent smoker meeting of the New York University Student Chapter. The meeting was attended by 90.

SHOWN HERE AT RECENT SMOKER MEETING of New York University Student Chapter are (left to right) John Murray, secretary; Daniel Koffler, vice-president; Douglas Jones, president; Prof. D. S. Trowbridge, Faculty Adviser; Dr. Ole Singstad, speaker of evening; Prof. R. L. Lewis, newly appointed head of civil engineering department; Vincent Cartelli, Contact Member; and Carmine DeVito, treasurer.

NEWS BRIEFS

J. F. Jelley, M. ASCE, to Head Navy Bureau of Yards and Docks

ANNOUNCEMENT OF PRESIDENT Truman's appointment of Capt Joseph F. Jelley, Jr., M ASCE, to a four-year term as chief of the Navy's Bureau, of Yards and Docks, succeeding Rear Admiral John J. Manning M. ASCE, who is retiring from active duty, has been made by the Civil Engineer Corps. Admiral Manning has accepted the position of executive vice-president of John McShain, Inc., Philadelphia construction company that was recently awarded the contract for renovation of the White House.

Captain Jelley

Admiral Manning

Captain Hunter

As deputy chief of the Bureau since February 1946, Captain Jelley has played a key role in Navy construction of permanent peacetime structures, principally housing, hospitals, and research facilities. His wartime service included assignments as officer in charge of construction of the Navy's major air base at Alameda, Calif.; deputy director of the Construction Department of the Bureau in Washington; officer in charge of the Bureau's Advance Base Division in Chicago; and executive officer of the Fifth Naval Construction Brigade at Guam. His appointment as head of the Bureau will elevate him to the rank of rear admiral.

Capt. Archibald D. Hunter, M. ASCE, has been appointed by Captain Jelley to the post of deputy chief of the Bureau. Captain Hunter is known for his wartime work as assistant public works officer of the 14th Naval District, in which capacity he supervised the vast construction program of public works and utilities at Pearl Harbor. Later he was ~~officer in~~ charge of the Seventh Construction Brigade, at San Francisco, and on the staff of the Commander of Naval Forces in the Philippines. Recently he has been serving on the staff of the Chief of Naval Air Training at Pensacola, Fla.

In the Civil Engineer Corps since 1918, Admiral Manning was instrumental in the organization and administration of the Seabees during the war. He has directed both the Atlantic and Eastern Pacific Divisions of the Navy. He retires with the permanent rank of rear admiral.

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Slight Drop in Construction Foreseen in 1950

THE CONSTRUCTION VOLUME in 1950 will be very close to the 1949 volume, with odds favoring a moderate reduction in the total of contract dollars rather than an increase, according to the F. W. Dodge Corp., fact-finding organization for the construction industry. In an analysis of a recent opinion survey made by the corporation among economists in industrial and research organizations and universities, Thomas S. Holden, president of the corporation, and Clyde Shute, manager of its Statistical Research Division, predict that the 1950 construction market will be a buyers' market. Restoration of normal competition is one phase of the current adjustment that may be said to be completed in construction and in most other sectors of business, they state.

Predictions of the group include continuation of market readjustment in 1950 and moderate downtrends in wholesale commodity prices, cost of living, consumer spending, and industrial and general business activity. Also forecast is a reduction in the volume of private non-residential building and an increase in the volume of public non-residential building.

While two-thirds of the group surveyed expects a reduction in housing volume, the other third anticipates moderately increased housing activity. The consensus is that the enlarged public housing program, authorized by the Housing Act of 1949, will not on a long-range basis increase the total number of units to be built. Seen as factors tending toward some curtailment of housing volume are the current reduction of new family formations that will at some stage reduce the basic demand for new dwelling units, and the possible abandonment of rent control in 1950 with "consequent shifting of rental housing occupancy."

Involved in any forecast of the future, the analysts emphasize, are such imponderables as the labor situation and the impact of foreign economic conditions on the American economy.

Joint predictions of the U.S. Departments of Commerce and Labor, made available in a recent Industry Report, anticipate that the construction total for 1950, both in dollar value and physical volume, will equal the 1949 probable total of $\$19^{1}/_{4}$ billion. These predictions are based on the expectation that outlays for private construction in 1950 probably will drop about $925 million from the total for 1949, but that public construction expenditures will increase by a like amount.

According to the two Departments, construction costs are expected to show a slight upward tendency early in 1950, but the average for the year probably will be the same as for 1949. During the current year, the Department of Commerce Composite Index of Construction Costs declined gradually from 211.3 (1939 = 100) in January to a low point of 205.1 in August. It turned upward slightly in September and October and it appears likely that further small advances will be registered for the remaining months of 1949.

Requirements for some materials such as lumber and paint may be slightly lower in 1950 than 1949, but other materials, such as cement and reinforcing steel, probably will be in somewhat greater demand giving support to current price levels for materials. Existing wage rates for construction workers also will tend to be sustained by anticipated full employment in the construction industry next year.

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Supply Problems Stressed at Hydraulics Conference

OPEN FIRE HYDRANTS constitute one of the worst problems for engineers in charge of the Chicago water supply, Fred G. Gordon, M. ASCE, assistant city engineer, told hydraulic experts from all over the country in attendance at the recent two-day National Conference on Industrial Hydraulics in Chicago. Despite the fact that the help of the police and fire departments has been enlisted and that special hydrant caps have been installed in some areas, Mr. Gordon said, vast quantities of water are lost through open hydrants especially in the summer.

Another prime cause of waste of water, according to the speaker, is leaking plumbing fixtures in private dwellings. A house-to-house inspection of plumbing fixtures begun in 1942, he said, has resulted in marked reduction of leakage.

The two-day industrial hydraulics conference was sponsored by the Armour Research Foundation of Illinois Institute of Technology and the Graduate School there.

Construction in November Remains Firm, Despite Slight Decline from October

ALTHOUGH THE NOVEMBER total of new construction, valued at more than $1.7 billion, was down 8 percent from the revised October estimate, it was 6 percent more than the total for November 1948, according to a joint report of the Department of Commerce and the Labor Department's Bureau of Labor Statistics. The general firmness of construction activity so late in the building season was one of the strong points in the national economy, the report states. Against the seasonal downtrend, there was an actual rise in construction of retail stores, office buildings, and schools.

Private non-farm homebuilding during the month was valued at $700 million, a decline of 3 percent from the revised estimate for October, but 14 percent more than the November 1948 figure. The total value of new non-farm residential construction put in place through November this year, however, was still 5 percent less than in 1948, largely as a result of the lag in homebuilding early in the year.

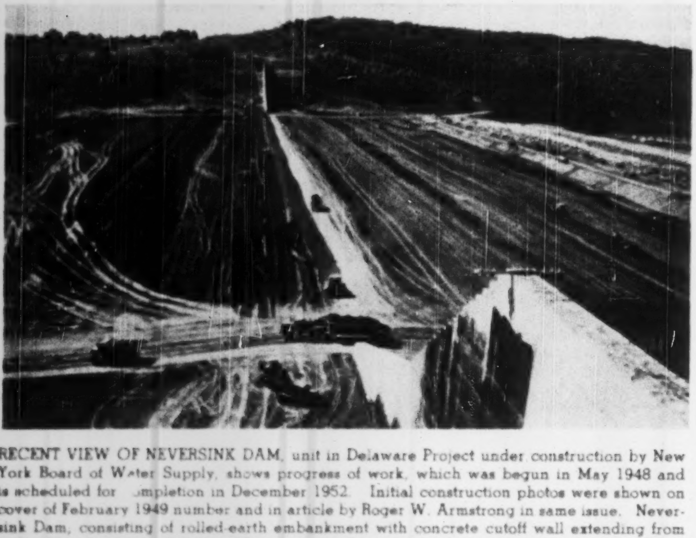
Building activity on most types of private non-residential structures in November equalled or exceeded October levels, in contrast to seasonal declines usually expected this time of year. The small contra-seasonal advance in construction of stores, restaurants, garages, warehouses, and office buildings is attributed to the large volume of contracts let for construction of this type early in the fall. Industrial, religious, and hospital construction also held up well.

Publicly financed new construction, which amounted to $466 million for the month, showed a 13 percent drop from the revised total for October, but was 19 percent more than the November 1948 total. Seasonal declines featured all principal types of public construction, except educational buildings, which advanced 3 percent, and hospital construction that was off only slightly from recent exceptionally high levels.

Summarizing the situation for the whole eleven months, the report states that a record year in terms of dollars spent for new construction is now virtually assured for 1949. The total value of new construction put in place by the end of the month reached $17.7 billion, which was 2 percent above the total for the first eleven months of last year. Though private construction lagged by 5 percent, public agencies spent 25 percent more for construction this year than last.

Production of building materials advanced contra-seasonally in September, according to the Department of Commerce. Output for the month, as measured by the Department's composite index, was 1 percent above August levels, but still about 6 percent below production in September 1948. The seasonally adjusted index of materials production rose to 137.4 in September (1939 monthly average = 100) compared with 129.5 in August and 146.8 in September 1948.

Construction Progresses on Neversink Dam



RECENT VIEW OF NEVERSINK DAM, unit in Delaware Project under construction by New York Board of Water Supply, shows progress of work, which was begun in May 1948 and is scheduled for completion in December 1952. Initial construction photos were shown on cover of February 1949 number and in article by Roger W. Armstrong in same issue. Neversink Dam, consisting of rolled-earth embankment with concrete cutoff wall extending from bedrock, is similar in design to Merriman and Downsville dams, the other units in the Delaware Project. When completed sometime in 1956, the Delaware project will augment the New York City water supply by 540 mgd at total cost of $350,000,000. Photo courtesy of Marion Power Shovel Co.

Army Engineers to Ask Bids on Pacific Northwest Work

NEW CIVIL CONSTRUCTION work in the Northwest and Alaska, totaling about $116,000,000, will be placed under contract in the next few months by the various districts of the Corps of Engineers in the North Pacific Division area, according to an announcement from Col. O. E. Walsh, North Pacific Division engineer.

New construction at Lookout Point Dam on the Middle Fork Willamette River, estimated to cost about $39,000,000, accounts for a considerable portion of the total figure. The largest single contract on the project is that for the concrete gravity spillway and earthfill dam, for which a tentative advertising date of March 1 has been set. The bid opening will be April 20. Ten other major contracts on the project, three of which are estimated to cost more than $1,000,000, are scheduled for the fiscal year. Grouped with other flood-control projects in the Walla Walla district, estimated in the vicinity of $8,000,000, is a large single contract calling for earthfill construction at Lucky Peak Dam on the Boise River. Bids will be called about March 10 and opened April 22. Seven contracts in connection with Detroit Dam and reservoir on the North Santiam River, totaling about $4,000,000, are scheduled for bid opening between January and July by the Portland district. Largest among them is the powerhouse contract that will go out for bids about the middle of May for opening early in July.

A schedule of the major projects proposed is available from the headquarters of the North Pacific Division, 500 Pittock Block, Portland, Ore.

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Ocala, Fla., Lets Contract for Treatment, Disposal Plants

A CONTRACT FOR the construction of new water-treatment and sewage-disposal plants in Ocala, Fla., has been awarded to F. H. McGraw & Co., engineers and constructors of New York, Hartford, and Chicago, according to an announcement from Clifford S. Strike, M. ASCE, president of the organization. Construction of the two projects, to cost $673,205, will get under way immediately. James Leahy, veteran company superintendent, will be in charge of construction.

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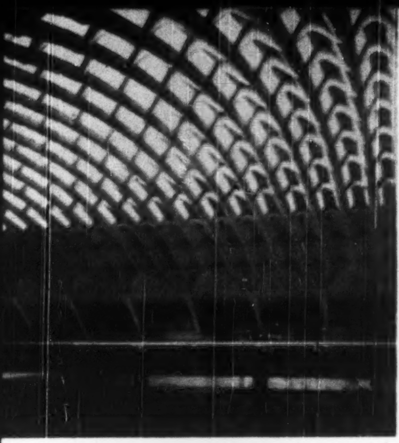
White House Subcontract Goes to New York Firm

A SUBCONTRACT FOR underpinning the White House has been awarded to the New York City firm of Spencer, White & Prentis, foundation specialists, for a fixed fee of $48,250 on work that will total about $775,000. As announced in the December issue, the over-all contract went to John McShain, Inc., of Philadelphia.



EXHIBITION HALL IN TURIN, ITALY, exemplifies spectacular use that is being made of reinforced concrete in postwar Europe. Approximately 295 ft in width, structure is spanned with 400 prefabricated reinforced concrete units. Under sides of ribs are special lighting tubes. Construction engineer on project is Pierre Luigi Nervi, Rome.

Advance Planning Program Is Furthered by GSA

Establishment of division offices to facilitate the distribution of advance planning loans to the states is announced by the Community Facilities Service of the General Services Administration. As announced in the December issue, the GSA will make allotments to the states from an initial appropriation of $12,000,000 made available by the 81st Congress.

Funds are available as loans, without interest, to states, cities, counties; school, sanitary, levee, and drainage districts; and similar political subdivisions. They are to be used to finance engineering, architectural, and economic investigations; studies, surveys, plans, and designs; and the making of drawings and specifications preliminary to construction. Improvements for which loans are available include highway, bridge, viaduct, grade-separation, and airport projects; sanitary, educational, hospital and health facilities; nonfederal public buildings; parks and recreational facilities; and other public projects, such as transportation, port, power plant, and distribution facilities; and non-federal river and harbor improvements.

Application forms and regulations to use in obtaining the loans will be available at the division offices that are being set up. These are located in New York City (Room 437, 42 Broadway); Washington, D.C. (1729 New York Ave., N.W.); Atlanta, Ga. (114 Marietta St., N.W.); Chicago (Room 1122, U.S. Post Office); Kansas City, Mo. (1811 Fidelity Building, 9th and Walnut Sts.); Fort Worth, Tex. (1003 Texas & Pacific Bldg.); San Francisco (Room 835, U.S. Appraisers Bldg., 630 Sansome St.); Seattle (Room 511, 618 Second Ave.); Denver (Room 420, New Custom House); Juneau, Alaska; and San Juan, Puerto Rico (501 Banco Popular Bldg.).

Advocates Conveyor System for Handling N.Y. Traffic

Use of mechanical belt conveyors below New York City streets to handle both people and cargo was suggested as a solution to the metropolitan traffic problem by Harold von Thaden, vice-president of Hewitt-Robins, Inc., before the recent 70th annual meeting of the American Society of Mechanical Engineers in New York. To handle cargo in this manner, he said, would rid the city of at least 25 percent of the truck traffic that congests the mid-town area. Already a major hotel chain is contemplating luggage conveyors running from street curb to hotel lobby, he pointed out.

In place of the crowded subway shuttle between Times Square and Grand Central, Mr. von Thaden suggested installation of a moving sidewalk, with a connecting link to Pennsylvania Station. Similarly, he said, construction of large trucking depots at the edges of the central business district and moving their cargoes into the city on a public conveyor system would do much to relieve traffic congestion. Mr. von Thaden explained that such a conveyor system could be suspended overhead or run underground, with operation on a charge per tonnage basis paid for by the user.

The highly diversified program presented at the week-long meeting included a session of the Applied Mechanics Division of ASME, co-sponsored by the Applied Mechanics Committee of the ASCE Structural Division. A paper on the vibration of structural elements was presented at the joint session by Prof. R. D. Mindlin, M. ASCE.

Total attendance at the meeting was 5,500.

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Slight Slump in Road Construction Reported

Highway improvements involving work on 25,828 miles of road and totaling $647,485,000 were let to contract by state highway departments during the first seven months of this year, according to reports received by the Bureau of Public Roads. These figures are slightly lower than the $684,560,000 worth of construction work on 26,470 miles of roadway for which contracts were awarded between January and August of last year.

Projects financed partly or entirely by federal funds accounted for $389,504,000 of the total cost of road work contracted for during the past seven months. The federal contribution amounted to $208,578,000.

Pennsylvania, with a total of $69,236,000, led the states in the dollar volume of contracts let in the first seven months this year. New York was second with a total of $60,751,000, Texas third with a total of $57,405,000, and California fourth with a total of $38,136,000. In total mileage of road improvements contracted for Texas was first with 3,688 miles; Ohio second, with 2,305 miles; Kentucky third, with 2,044 miles; and Kansas fourth, with 1,251 miles.

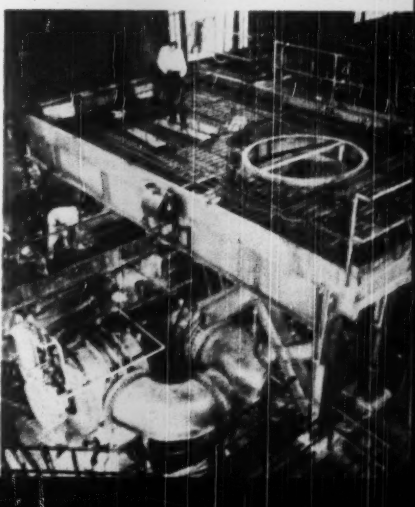
City of Chicago Selects Filtration Plant Site

A site for location of Chicago's new $76,000,000 filtration plant, which will provide a domestic water supply for the central and northern areas of the city, was approved by the City Council on November 29. The location chosen for the 950-mgd plant—a short distance offshore in Lake Michigan, 1,500 ft east of Lake Shore Drive and 400 ft north of Navy Pier—is approximately 1,000 ft east of the site recommended by engineers retained by the city to advise on location, which was opposed as violating property rights. Approval was given the present site in the belief that there will be no violation of riparian or other rights.

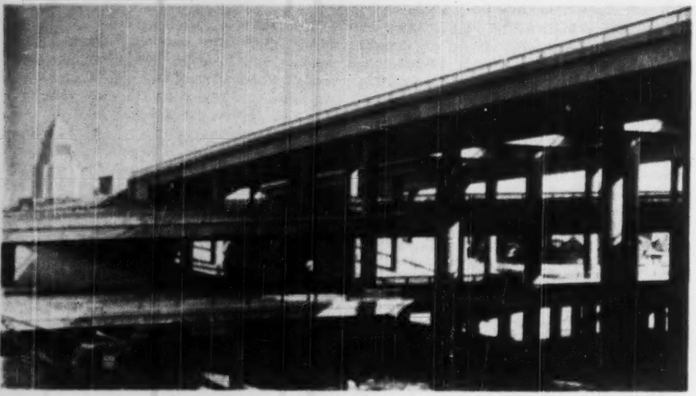
A 60-acre area, 2,500 ft long and 1,100 ft wide, will be occupied by the plant. Present plans call for dewatering the entire site, which is about 16 ft under water, by building a cofferdam prior to beginning construction of the plant proper.

The action of the City Council culminates a three-year study by the Council and its committees and the engineering staff of the Department of Public Works, which will be in charge of design and construction. The Filtration Design Section is under the direction of W. W. De Berard, Hon. M. ASCE, city engineer, and O. E. Hewitt, commissioner of public works. F. G. Gordon, M. ASCE, is assistant city engineer in charge of design; J. R. Baylis, Assoc. M. ASCE, engineer of water purification; and George S. Salter, M. ASCE, filtration design engineer. Consultants on the project were S. A. Greeley and L. R. Howson, Members ASCE.

NEW 100-MGD WATERWORKS PUMP is installed for City of Pittsburgh at its Ross Pumping Station by Dravo Corp. To ensure protection against floods, 1,250-hp pump motor is on reinforced concrete platform above highest flood level ever reached by Allegheny River at the station. Engineers in charge of design and construction are James H. Kennon and Morris L. Wolf, managing engineer and mechanical superintendent, Bureau of Water, City of Pittsburgh. Ross Station is considered one of outstanding municipal waterworks pumping installations in the country.



Los Angeles to Have Unique Parkway Intersection



FOUR-LEVEL INTERSECTION, under construction by California Division of Highways near downtown Los Angeles, at junction of Arroyo Seco–Harbor and Hollywood–Santa Ana freeways, will provide for full rerouting of traffic between these arterial routes. A new method of handling interchanges of traffic between arterial highways, completed project will provide increased capacity over conventional cloverleaf and will form hub of extensive parkway system. Los Angeles City Hall is shown in background. Cost of structure is $1,500,000. Photo courtesy of Milan McDowell, Los Angeles.

AASHO Urges Annual Federal Aid for Interstate System

ANNUAL ALLOCATION OF $210,000,000 in federal aid funds for the interstate highway system on a 75-25 matching basis was urged by the American Association of State Highway Officials at a recent special meeting in Chicago. The association adopted a statement of national policy on the matter and early in 1950 will recommend to Congress an expanded highway program calling for total federal-aid authorizations of $810,000,000. The recommendation for matching funds on a 75-25 basis contrasts with the 50-50 matching basis on the primary, secondary, and urban programs.

Included in the AASHO statement of policy are recommendations for apportionment of interstate funds on the basis of the population of the state, with no state receiving less than three-quarters of 1 percent. Also advocated is a specific appropriation of $100,000,000 for the purpose of advancing funds to the state highway departments for the acquisition of rights-of-way to be repaid over an extended period of years, and a 50 percent increase in the present one-third limitation on federal aid for right of way.

Pointing out that allocations of last year's funds, provided for in the 1948 Act, were made in the past October, the AASHO statement remarks that continuance of the federal-aid program depends on immediate congressional action. New allocations would become effective for the fiscal year of 1952, but federal-aid authorizations for highways must be enacted well in advance of the actual date of availability of funds, so that both federal and state governments may make necessary long-range plans well in advance of the actual initiation of the program. It was with cognizance of these conditions that the AASHO formulated its policy.

◆

Increased Industrialization Sought by Colombian Engineers

A PAPER ON the proposed Paz del Rio Steel Plant in Colombia highlighted the five-day technical program presented during the recent second National Engineering Congress of Colombia at Cali. With the attention of the country currently focused on the possibility of manufacturing steel and the government making every effort to initiate the industry, Colombian engineers discussed the paper at great length. Authors were Dr. Joaquin A. Prieto Isaza, Dr. Benjamin Alvarado, and W. A. Leech. According to a survey made for the government by the Koppers Co., of Pittsburgh, Colombia has the necessary physical elements for making steel, and a method of financing is being formulated. The country annually imports about 170,000 tons of steel products.

Another paper of seeming special interest to the engineering group was on the "Status and Future of the Electrical Industry in Colombia," presented by Dr. Miguel Caicedo and discussed by Dr. Julian Cock. In most of the larger cities of the country there is a serious shortage of electrical power, and many of the smaller communities are trying to develop local light and power supplies. The National Institute for Water Control and Hydroelectric Development, organized several years ago under Dr. Cock's direction, is reported to be making substantial progress in coordinating and controlling the distribution of water for irrigation, hydroelectric power, and other uses.

Called with the objective of strengthening ties between the various engineering groups of the nation, the Colombian Congress proved highly successful. Dr. Pedro V. Charria and Dr. Juan Beron, president and secretary of the Association of Engineers of Valle del Cauca, were elected president and secretary of the congress, which was sponsored by the Colombian Society of Engineers. Plans for a third congress, to be held at Barranquilla in 1952, are already under way.

◆

Port Authority Lets Contract for Midtown Bus Terminal

THE PORT OF New York Authority has announced the award of a $9,194,759 construction contract to the Turner Construction Co., of New York City, for the superstructure of the Port Authority's huge bus terminal in mid-town Manhattan. The contract for the superstructure includes walls, interior construction, and all major mechanical and utility installations. An overhead elevated highway connecting the terminal directly to the Lincoln Tunnel will expedite the handling of the 130,000 bus passengers expected to use the terminal daily.

Erection of steel framework for the building was started November 23, and completion is scheduled for November 1, 1950.

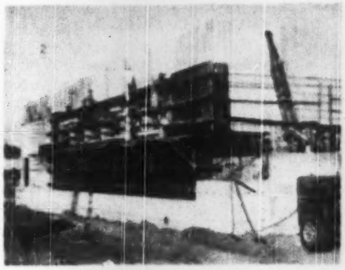
◆

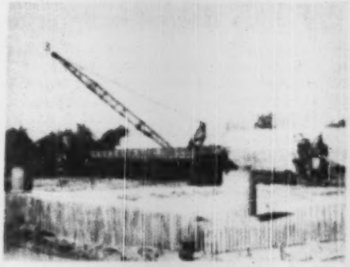
Steel Output for Year Drops After Record Rise

STEEL PRODUCTION FOR 1949, with a total output of about 76,000,000 tons, was 12,000,000 tons below the record peacetime production achieved in 1948, according to the American Iron and Steel Institute in a recent issue of its publication, *Steel Facts*. Despite this drop in production, however, output for the year was the third largest in the history of peacetime production.

Production losses are attributed largely to the steel strike, which in October alone caused a loss of about 6,000,000 tons of ingots, the equivalent of nearly 4,500,000 tons of finished products. This loss in output, according to the Institute, "equals at least four months' shipment to the automotive industry at record level, or six months of direct shipments to the construction industry."

Quarterly production was the highest ever attained in the first quarter of 1949 with output exceeding normal capacity by 1.5 percent. During this period supply caught up with prolonged top level demand. Subsequently production declined to a low point of 70.9 percent of capacity in July, from which it recovered to 83.5 percent in September.





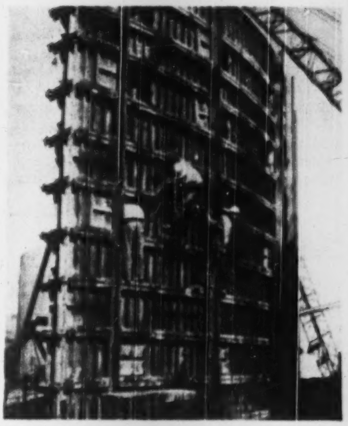
Oklahoma City's Sewage Plant Nears Completion

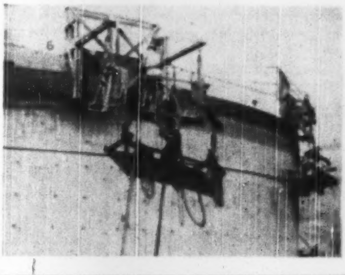
Oklahoma City's $4,000,000 sewage treatment plant, a two-stage trickling-filter unit with a capacity of 25 mgd, described in Civil Engineering for May, has been under construction for a year. Despite a severe winter season at the start of construction, the concrete work, totaling 27,250 cu yd, was 80 percent complete by December 1949. The main pump station is completed up to the roof beams, and the pumps and engines are ready to be placed on their foundations. The administration building will be completed and equipped soon after January 1.

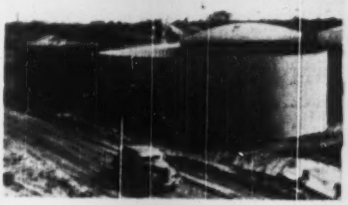
Work on the detritors is underway. The walls of all eight digesters have been poured, and on three of them the walls have been wrapped with prestress wire, covered with Gunite, and the domes are in place. All underground conduits and sludge lagoon levees are completed. The final tanks and sludge drying beds of the original plant at the site will be rehabilitated for the new plant after the new work is completed.

Illustrations on this page show construction progress on the clarifiers, digester tanks, and pump station. The construction contract was awarded to Earl W. Baker & Co., of Oklahoma City. The Benham Engineering Co. drew the plans and is directing construction. Effluent from the plant is to be discharged into the North Canadian River, which is usually dry.

FOUR CIRCULAR PRIMARY TRICKLING FILTERS are approaching completion in Photo 1 (above). Nearest filter, with crushed rock in place on top of filter block, is ready for installation of distributors. Steel forms are used for erecting reinforced concrete walls of 53 by 98-ft pump-lift station (2). Roof of pumping station is 44 ft. above lower floor. In Photo 3, concrete is being poured in walls of one of four square primary clarifiers. Digester tanks, 90 ft in diameter (shown in background) will be wound with prestress wire. Steel forms are being erected in Photo 4 for section of circular digester tank. Completed tanks (5) are ready for prestressing. There are six primary and two secondary tanks, the former with domed roofs, the latter with floating gas holders. Photo 6 shows winding machine in operation, followed by a carriage from which prestress wire is covered with Gunite.







BRAB to Study Effect of Weather on Building Industry

A First Research Correlation Conference has been called by the newly organized Building Research Advisory Board for January 11 and 12 in Washington, D.C. The theme of the two-day program is "Weather and the Building Industry," and climatological and building experts from all over the United States and Canada are slated to discuss the possibilities of related research in the two fields.

Headquarters of the conference will be the National Academy of Sciences. Interested persons should get in touch with William H. Scheick, executive director of BRAB, National Research Council, Washington 25, D.C.

Objectives of BRAB were outlined by Mr. Scheick at a recent luncheon held in conjunction with a meeting of the Construction and Civic Development Department of the Chamber of Commerce of the United States in Washington. He told the group that building research should be conducted on a straight-line basis, beginning with design and engineering, and progressing to materials and equipment, distribution, and finally methods of constructing the end product. Correlating functions of the board were stressed by W. H. Foreman, managing director of the Associated General Contractors, who presided at the luncheon. Mr. Foreman also warned of the necessity of being ever "alert to adopt new materials and methods."

Formation of BRAB, a research and correlating service for the construction industry, was sponsored by the National Research Council and other agencies.

Funds Distributed for National Forest Roads

Apportionment of $20,000,000 for improvement of highways in national forests in 40 states, Alaska, and Puerto Rico for the 1951 fiscal year starting July 1, 1950, has been announced by Secretary of Commerce Charles Sawyer. Apportionment is made on the basis of area and value of government land in the national forests in each state, under authorization of the Federal-aid Highway Act of 1948. Expenditure is administered by the Bureau of Public Roads.

The approved forest highway system consists of approximately 23,250 miles. During the past fiscal year improvements were completed on 232 miles at a cost of $8,101,568. Projects still under construction at the end of the year totaled 521 miles, with an estimated cost of $23,942,000.

Florida University Sponsors Surveying and Mapping Conference

Problems and techniques of mutual interest to mapping organizations, land surveyors, and real estate interests were studied at the recent second annual Surveying and Mapping Conference, to which the University of Florida was host in Gainesville. In a leading paper, E. R. Lampp, consulting engineer of Ocala, called on the land surveyors of Florida to improve the standards of their work and to cooperate with each other for the betterment of the profession. His ideas and suggestions were endorsed in a resolution adopted by the conference.

The 230 civil engineers, surveyors, engineering students, and real estate representatives in attendance also went on record as favoring continued efforts to establish a central state organization for the collection and dissemination of maps and mapping information as recommended by the 1948 conference.

The four principal topics considered in the two-day program were New Developments and Techniques in Surveying and Mapping, Federal Mapping Agencies and Their Programs; the Florida State Coordinate System; and the Problems of the Land Surveyor. ASCE members taking part in the program included George D. Whitmore, chief of technical staff, U.S. Geological Survey, Washington, D.C.; Thomas L. Bransford, assistant professor of civil engineering at the University of Florida; Jon S. Beazley, of the Florida State Road Department; H. D. Mendenhall, Tallahassee consultant; and F. H. Crabtree, associate professor of civil engineering at the University of Florida.

John S. Telfair, Jr., Jun. ASCE, represented the Florida Section on the planning committee, and Russell De Grove, Assoc. M. ASCE, the Florida Engineering Society. The conference was sponsored by the College of Engineering at the university.

◆

Contractor for Gaseous Diffusion Plant Chosen

Preliminary construction work on a fourth gaseous diffusion unit in the Oak Ridge, Tenn., area is scheduled to start soon, with the recent award of a construction contract to the Maxon Construction Co., Inc., of Dayton, Ohio, according to an announcement from the Atomic Energy Commission. Designated K-31, the new unit will be fourth in a series of gaseous diffusion plants under construction as part of the Oak Ridge Project. Cost of the new plant will be about $162,000,000.

Architect-engineer on the project will be Giffels & Vallet, Inc., of Detroit, who already are engaged in building K-29, third unit in the project.

◆

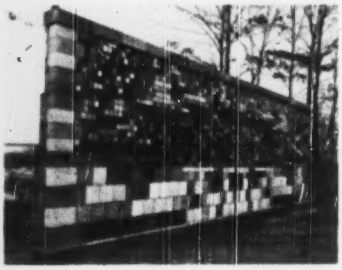
Concrete Experts Hold Regional Meet in Boston

Huge concrete structures now under way or recently completed were described to more than 400 members of the American Concrete Institute at a recent two-day meeting of the ACI in Boston. The reinforced concrete aircraft hangars, just completed at Limestone, Me., and Rapid City, S.Dak., for the U.S. Air Force, were explained at the opening session by John E. Allen, Assoc. M. ASCE, chief of the engineering division of the Boston District of the U.S. Engineer Office. Floor drains for these vast structures, Mr. Allen said, had to be adequate not only for normal drainage, but also to handle a fire-sprinkler system discharge of nearly 20,000 gpm.

Cements made from volcanic materials that reduce shrinking and heating while the cement is being poured were described by Raymond E. Davis, M. ASCE, director of the Engineering Materials Laboratory at the University of California. Other ASCE members on the program included C. H. Scholer, head of the Department of Applied Mechanics at Kansas State College, who made optimistic predictions for the future of the concrete industry; W. S. Colby, structural engineer for the Stone & Webster Corp., who spoke on design and construction of a circulating water intake for Venice No. 2 Power Plant; and Robert C. Hanckel, consulting engineer, whose subject was "Precast Units for Short Span Bridges."

Albert Haertlein, nominee for ASCE Vice-President and professor of civil engineering at Harvard University, was chairman of the dinner meeting program.

Experimental Masonry Wall Will Test Stone



AGING AND WEATHERING OF STONE will be studied by means of experimental masonry wall recently erected at National Bureau of Standards. Wall, shown here, is faced with more than 2,000 specimens of stone from 47 states and 16 foreign countries. Cooperative project initiated by Bureau of Standards and American Society for Testing Materials, study is expected to aid in developing more reliable laboratory methods for predicting durability.

AEC Awards Contract for Nuclear Reactor in Idaho

Selection of the Bechtel Corp., of San Francisco, to perform major construction work on the first reactor to be built at the new Nuclear Reactor Testing Station near Arco, Idaho, is announced by the Idaho Operations Office of the Atomic Energy Commission. Objectives of the reactor program include the development of nuclear reactors for production of fissionable material, generation of electric power, and propulsion of ships and aircraft. Work on the reactor will begin at once, and completion is expected by the end of 1950.

◆

Internships Offered by U.S. Bureau of Standards

Opportunities for outstanding students in engineering and science to broaden their undergraduate or graduate training through vacation-time employment and graduate fellowships are announced by the National Bureau of Standards, which has established a work-study program for the selection and training of its research personnel. Under the provisions of the program, the student is permitted to alternate periods of full-time study with actual work experience in his chosen field, supplemented by on-the-job training and orientation courses at the Bureau.

Undergraduate internships, qualifying candidates for permanent professional appointment after graduation, carry a stipend of $208 a month for those with two years of college credit, and of $227 for those who have completed their junior year. In the graduate fellowship program, a limited number of research fellowships with a value of $2,974 a year, are available.

Further details may be obtained from the Personnel Division of the National Bureau of Standards, Washington 25, D. C.

◆

Soils Conference Papers Ready for Distribution

Availability of the Proceedings of the Second International Conference on Soil Mechanics and Foundation Engineering, held in Rotterdam in June 1948, is announced by Donald W. Taylor, secretary of the International Society of Soil Mechanics and Foundation Engineering. Volumes I to VI, containing almost 500 articles on soil mechanics subjects by authorities from many countries, may now be purchased in this country at the reduced dollar rate of $21. Volume VII, scheduled for publication in limited supply, will be $4. The entire Proceedings is in English.

Orders and remittances may be mailed to Professor Taylor, Room 1-330, Massachusetts Institute of Technology, Cambridge 39, Mass. Checks should be made payable to the Department of Civil and Sanitary Engineering at M.I.T.

N. G. NEARE'S
Column

R. Robinson Rowe, M. ASCE

Everybody knew Joe Kerr had the answer. Joe's such a naive, uninhibited extrovert that his face and table manners told the story all thru dinner; he could hardly wait his chance to reveal the solution of the 8-number problem. The Professor just grinned and waved the floor to Joe.

"This time, Professor Neare," said Joe, "I tried the easy synthetic way. The simplest 8-number group, 0, 0, 0, 0, 0, 0, 0, 1, reduced by absolute differentiation to zeros in 8 steps. Since changing the last number changes each item of the steps in proportion, I started on groups with 6 zeros. When 0, 0, 0, 0, 0, 0, 1, 3 took 14 steps, I knew I was warm, but I couldn't seem to gain until I tried 0, 0, 0, 0, 0, 0, 2, 7 and found 15 steps. An hour later I had it; 0, 0, 0, 0, 0, 0, 3, 11 took just 20 steps like this:

0	0	0	0	0	3	8	11	0	2	4	6	0	2	0	2
0	0	0	0	3	5	3	11	2	2	2	6	2	2	2	2
0	0	0	3	2	2	8	11	0	0	4	4	0	0	0	0
0	0	3	1	0	6	3	11	0	4	0	4	0	0	0	0
0	3	2	1	6	3	8	11	4	4	4	4	0	0	0	0
3	1	1	5	3	5	3	11	0	0	0	4	0	0	0	4
2	0	4	2	2	2	8	8	0	0	4	4	0	0	4	4
2	4	2	0	0	6	0	6	0	4	0	4	0	4	0	4
2	2	2	0	6	6	6	4	4	4	4	4	4	4	4	4
0	0	2	6	0	0	2	2	0	0	0	0	0	0	0	0

Having tried all smaller combinations, I'm sure this is the least set."

"But," butted Cal Klater, "Noah asked for 'the least set of 8 *different* numbers . . .' and Joe used 6 extremely similar zeros in his set. By analysis I found that a set would approach zeros very slowly if it was a geometric series $a, ar \ldots ar^7$ with the 8th term equal to the sum of the first seven, making $r = 1.9919642$. Trying the set 1, 2, 4, 8, 16, 32, 64, 127, I found 32 steps to zeros. The 12th step reduced to simplest terms gave me a solution 0, 1, 6, 5, 10, 13, 22, 49. Looking for a smaller one, I started with 0, 1, 2, 4, 8, 16, 32, 64 which has 26 steps; the 6th step gave me 0, 1, 2, 3, 10, 13, 32, 61, but this is larger than my first solution. So I reverted to synthesis and played with sets like 0, 1, 2, 3, 4, 5, x, y until I found the least: 0, 1, 2, 3, 4, 5, 7, 14."

"Which is my least also," agreed the Professor, "altho neither of us has eliminated sets not in ascending order. Now, leading up to something else, I learned years ago in Alaska that there were no snakes because the mosquitos and no-see-ems killed them. Our Guest Professor, Sauer Doe, has corrected me, but I'll let him tell the story himself."

"They were cannibalistic, Noah. The last three formed a circle as each started swallowing another tail first. The circle got smaller and smaller as the swallowing continued steadily until finally each gave a gulp and all disappeared. Almost unbelievable, but indisputable; no snakes are left. Now, if each snake was 5 ft long and weighed 4 lb, how much snake had each snake swallowed when the tightening circle was just one foot in circumference?"

[*Cal Klaters who came close enuf to the least set were: Stoop (John L.) Nagle, Anne Othernut (J. Charles Rathbun) and D. B. (Canby Dunn) Steinman. Guest Professor Sauer Doe is Marvin A. Larson, who admits his snake story is a bit colored; they really died in an epidemic of mumps.*]

Meetings and Conferences

American Concrete Pipe Association. Headquarters of the 42nd annual convention of the American Concrete Pipe Association will be the Fairmont Hotel, San Francisco, Calif. The dates are February 22-25.

American Institute of Electrical Engineers. The winter meeting of the American Institute of Electrical Engineers is to take place at the Hotel Statler, New York City, January 30 through February 3.

National Research Council. Climatological research and its effect on building design, construction, materials, and equipment will be discussed during the first research correlation conference of the new Building Research Advisory Board, an agency of the National Research Council, in Washington, D.C., January 11 and 12.

Society of Automotive Engineers. Technical and social activities of the annual meeting of the Society of Automotive Engineers are scheduled for the Hotel Book-Cadillac, Detroit, Mich., January 9-13.

Southwest Air Conditioning Exposition. New trends in structural design of air conditioning equipment will be displayed at the Southwest Air Conditioning Exposition, which is being held under the auspices of the American Society of Heating and Ventilating Engineers, coincidentally with its 56th annual meeting in Dallas, Tex., January 23-27.

◆

USBR Lets Supply Contract in Central Valley Project

Work on construction of the first unit in a water distribution system, under the Central Valley (California) Project, will soon get under way with the award of a $846,669 contract by the Bureau of Reclamation to the United Concrete Pipe Corp., Baldwin Park, Calif. The contract calls for construction of 25 miles of pipeline and appurtenant facilities for distribution of water from the Friant-Kern Canal to municipalities in southern San Joaquin County.

Another recent Bureau of Reclamation contract went to the Guy F. Atkinson Co., Portland, Ore., for construction of earthwork for the Potholes East Canal, part of the Columbia Basin Project in Washington. The amount of the contract was $937,602.

◆

ECPD Accredits Three New Civil Engineering Curricula

Undergraduate civil engineering curricula in three colleges have been accredited by Engineers' Council for Professional Development since the last ECPD report appeared. These are the University of Massachusetts, the University of Mississippi, and the University of Nevada.

The full list of accredited undergraduate curricula is available in a reprint from the ECPD Annual Report, dated October 28, 1949, which can be obtained from ECPD headquarters, 29 West 39th Street, New York 18, N.Y., for 25 cents.

◆

300-Year-Old Iron Is Found in Good Condition

First iron made in the United States more than 300 years ago was of good quality, somewhat similar to today's product though more brittle, according to an analysis of artifacts recently unearthed in the foundations of an old furnace near Lynn, Mass., the American Iron and Steel Institute reports. Excavators, working under the direction of the Institute and the First Iron Works Association, have uncovered many artifacts, including wrought-iron nails, bolts, wedges or chisels, a mattock head, large spikes, scale weights, parts of cast kettle rims, and numerous unidentified objects.

The iron, which was made at the furnace, was extracted from local ores in the blast furnace, using charcoal for fuel and clamshells and limestone for flux. Its physical structure, as revealed by the microscope, does not differ essentially from gray iron castings produced today, the Institute states. Chemically, however, it is lower in manganese and silicon and higher in phosphorous than modern iron, conditions tending to make it more brittle and less strong.

◆

Prizes Offered for Welded Bridge Designs

To encourage welded bridge construction, the James F. Lincoln Arc Welding Foundation is sponsoring its second "Welded Bridges of the Future" program. A first award of $5,000 will be made for the best design of a 250-ft welded highway bridge submitted in the 1950 program. The second award will be $2,500, the third, $1,250. Ten honorable mention awards of $200 each will also be given.

A copy of the rules and regulations governing the competition, which closes June 30, 1950, may be obtained from the James F. Lincoln Arc Welding Foundation, Cleveland 1, Ohio.

Engineers Cooperate in State Building Program

An example of highly successful cooperation between engineers in industry and government through the medium of a taxpayers' organization is reported by Col. William S. Weeks, president of the New Jersey Taxpayers Association. According to Colonel Weeks, the association wanted to determine, from the standpoint of the taxpayer, the actual merit of the proposed $25,000,000 bond issue for institutional improvement. "To get the answer to this question," he reports, "we asked three New Jersey industries with large building operations of their own to supply experienced engineers to examine the condition of the present buildings and study the separate construction and improvement projects for which the bond funds are requested.

"Beginning work on June 28, the committee over a period of three and a half months examined in detail every one of 101 proposed projects at 20 state institutions along with specifications, plans, maps, and other data prepared by the State Department of Institutions and Agencies. The results of the committee's survey were reported through the public press and helped win overwhelming approval for the institutional bond issue at the November 8 election. Voters, at the same time, rejected two other bond proposals for unrelated purposes."

The survey committee consisted of A. B. Heiser, M. ASCE, architect and engineer for the American Can Co.; R. W. Doering, advisory engineer for the Westinghouse Electric Corp.; and E. I. Merrill, plant engineer for the Johns Manville Corp.

◆

Record Engineering Enrollment Reported

Engineering schools are filled to capacity in practically every section of the county, according to the United States Office of Education, which predicts that the present peak enrollment will continue to be stabilized at its present level. Many have long waiting lists of qualified candidates, though some of the technological institutions that train for semi-professional work report that they are not overcrowded.

Enrollment in professional and technological schools this year, totaling 218,276, represents an increase of 9 percent over last year and a gain of 74 percent over 1941–1942.

◆

Use of Mountain Streams for Irrigation Advised

Mountain streams may very profitably be harnessed to increase the irrigated acreage in Nevada, according to H. V. Peterson, Assoc. M. ASCE, of the Los Angeles office of the U.S. Geological Survey. Speaking at the recent fourth Nevada Water Conference in Carson City, Mr. Peterson emphasized the importance of damming such streams to relieve the state's water shortage. While it is important to lay stress upon the development of extensive underground reservoirs within the valley area, he said, it is also important to think about the numerous small streams draining from the higher mountain ranges.

"These streams," he declared, "offer a challenge and an opportunity to materially increase the water utilization of the state. Having observed unused flowing streams while conducting field examinations of an unrelated nature, I am led to believe that if a concerted search were made in localities most favorable to the occurrence of such streams a considerable number of prospective developments might be found."

Urging that surveys be made of the flanks of every high mountain range and plateau area in the state, Mr. Peterson said that such examinations should be conducted in the spring during the snow melt period. "Every unused stream of any magnitude should be considered critically with the idea of putting it to work," he concluded, "for we can let this water be dissipated on the valley floor with little or no returns as at present, or we can make an effort to see that it produces to the maximum benefit of the whole state."

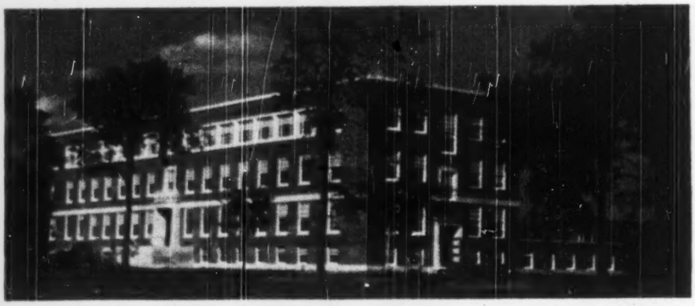
NEW IN Education

Fellowships, scholarships, and assistantships leading to the degrees of master of science and doctor of philosophy will be offered by the Illinois Institute of Technology for the school year 1950–1951 in business and engineering administration, city planning, civil engineering, mechanics, public engineering administration, and other fields. Fellowships permit the holder to obtain unusual experience in special fields of research or to apply full time to work carrying graduate credit. Scholarships covering tuition will be offered to exceptional students wishing to devote full time to graduate study. Teaching assistantships leading to a master's degree in four semesters, are available in all departments. The stipend for the initial academic year is $1,314, from which tuition of $275 is available. Full details may be obtained from the Office of the Dean, Graduate School, Technology Center, Chicago 16, Ill.

The civil engineering department of Columbia University has received a $7,000 grant from the Research Corp., according to an announcement from Dean James K. Finch, M. ASCE, of the School of Civil Engineering. The grant will be used for a research program, to be directed by Prof. Alfred M. Freudenthal, M. ASCE.

For the benefit of public officials, engineers, physicians, and others engaged in pollution control, the University of Michigan School of Public Health is offering a three-day inservice training course on the subject, February 6–8. A wide range of industrial pollution problems and factors of correction will be discussed. Applications for enrollment should be submitted promptly in writing to the School of Public Health. The enrollment fee is $5.

Latest developments in road-building methods will be emphasized at the third annual Northwest Conference on Road Building, to be held in More Hall on the University of Washington campus, February 6–8. More than 300 engineers from the Northwest, British Columbia, and Alaska are expected to attend the three-day program, sponsored by the university's civil engineering department and the student chapter of the American Roadbuilders' Association. Featured subjects will be the design of expressways, sub-grade exploration and frost-heave damage, and pavement design.



UNIVERSITY OF MAINE extends its technical facilities with dedication of new engineering and plant science buildings during recent two-day program featuring conference on "Maine Resources and Their Development." Engineering building, shown here, will be headquarters for civil and mechanical engineering departments, highway testing laboratories and offices, and courses in geology. Photo courtesy of Ted Newhall, Orono, Me.

A NEW $500,000 engineering building at the University of Akron was dedicated recently at an open house and dinner meeting. Named Ayer Hall in honor of Dean Emeritus Frederic E. Ayer, the new building is a reinforced concrete structure with brick and limestone exterior. Its four floors provide a total of 40,000 sq ft in floor space, which will house the departments of civil, electrical, and mechanical engineering and most of the mathematics department. The building was financed by donations from Akron industries and alumni, and is the second structure to be completed under the university's present extension program.

ESTABLISHMENT OF A division of engineering research in the engineering department of the University of California, Berkeley, has been announced by Morrough P. O'Brien, M. ASCE, dean of the College of Engineering. Through this new division, the university will make its resources available to assist industry and government in solving complex research problems for which no private facilities exist. Chairman of the new division and director of engineering research is Prof. Henry A. Schade, retired Navy commander and former director of the Navy's giant research laboratory in Washington, D.C. The engineering department currently has in progress research programs involving expenditure of more than a million dollars annually in the major engineering fields.

ESTABLISHMENT OF A group of new freshman-year scholarships in the Cornell University College of Engineering has been announced. Known as the Burrell Scholarships, the awards will be worth up to $200, depending upon academic record and need. Open to both men and women in any of the five undergraduate engineering divisions at Cornell, the awards will be made for the first time to students entering Cornell next September.

GUNNESS ENGINEERING LABORATORY, a $475,000 addition to the School of Engineering at the University of Massachusetts, was dedicated in recent ceremonies attended by Gov. Paul A. Lever. More than 100 noted educators and industrialists, heard President Ralph A. Van Meter rap sharply the tendency to over-specialize in technical fields while training men for industry. "Let us dedicate this laboratory," he said "to the development of open minds and sane, balanced and competent men. This is the greatest service we can render to them, to industry and to the nation."

Named for Christian I. Gunness, late head of engineering at the university, the laboratory contains classrooms and laboratories for the departments of civil, mechanical and electrical engineering that will accommodate about 500 students.

TECHNICAL EXPERTS FROM the Aluminum Company of America's development division and process development laboratories were in charge of a product design seminar held at Lehigh University recently. One of a series being conducted at Lehigh University under the auspices of the university and the Society of Industrial Designers, the seminar was devoted to aluminum.

NEWS OF Engineers

Edwin R. Schofield, formerly principal assistant engineer of the Bureau of Engineering, Survey and Zoning for the City of Philadelphia, Pa., has joined the consulting firm of Knappen, Tippetts, Abbett Engineering Co., and will be in charge of the Philadelphia office. Mr. Schofield headed a party of six engineers and contractors connected with the Walnut Lane Bridge in Philadelphia—the first prestressed concrete bridge in the United States—that visited Europe to get first-hand information on methods used there. He is the author of several CIVIL ENGINEERING articles on the Walnut Lane Bridge.

J. C. Penn has retired as professor of civil engineering at the Illinois Institute of Technology.

Col. Theron D. Weaver, of Detroit, Mich., former chief of the Construction Branch of the Engineer Division of the Corps of Engineers, will become deputy chief engineer, European Command, with headquarters at Bremerhaven, Germany.

Gerard Witt, formerly with Seelye, Stevenson & Value, has opened an office in New York City, where he will specialize in the practice of structural engineering. Mr. Witt graduated from City College of New York with a C.E. degree and served as an Engineer officer in the Corps of Engineers during the second World War.

E. H. Dunmire announces the formation of a partnership with **G. C. Ernst,** under the firm name of Dunmire & Ernst, consulting engineers, with offices in Lincoln, Nebr.

T. H. Dennis has retired as maintenance engineer of the California State Division of Highways, after 37 years of service. As chairman of the American Association of State Highway Officials committee on radio use, Mr. Dennis promoted the use of radio in the highway department and influenced the FCC decision to set aside a group of frequencies for use by highway departments.

Spencer, White & Prentice, Inc., of New York City, announce the acceptance with regret of the resignation of **Lazarus White,** who has been president of the company more than 30 years. Prior to the formation of this firm, Mr. White did pioneer work in New York subway construction. He is a specialist in the field of foundations and structures and the author of numerous reports and papers. Mr. White served the Society as a Director during the period from 1940 to 1942, and has been chairman of the Committee on Foundations of the Soil Mechanics and Foundations Division.

Lazarus White

Arthur E. Dodds, structural engineer and architect, of Seattle, Wash., has been named assistant city building superintendent.

S. R. Young, head of the Atlanta and West Point Railroad, the Western Railway of Alabama, and the Georgia Railroad, was recently elected a director of the Trust Company of Georgia. Active in Society affairs, Mr. Young is a past-president of the Georgia Section.

Robert Horonjeff, for the past five years chief of the Civil Works Branch of the San Francisco District of the Corps of Engineers, is now on the staff of the University of California's Institute of Transportation and Traffic Engineering, Berkeley. Mr. Horonjeff will serve the Institute as engineer and lecturer, specializing in airport engineering. Prior to his work with the Army engineers, he engaged in private practice and worked for the Bureau of Reclamation.

Herman S. Schick has retired from his post in the Nashville, Tenn., District office of the Corps of Engineers, after 39 years of service.

Brig. Gen. W. W. Wanamaker, who retired on November 30 after 31 years of active service in the Army Corps of Engineers, has been appointed executive director of the New Jersey Turnpike Authority. In his new position General Wanamaker will direct the executive and administrative affairs of the Authority. His services in the Corps of Engineers have included assignments as resident engineer on the construction of the Alton Lock and Dam on the Mississippi River above St. Louis; a four-year period as assistant to the Chief of Engineers, Washington, D.C.; and district engineer at Dennison, Tex., Baltimore, Md., and New York City, from which position he just retired. As first district engineer at Garrison, N. Dak., he initiated construction of Garrison Dam, key project in development of the Missouri River.

W. W. Wanamaker

Clarence B. Monk was named instructor in civil engineering at the Illinois Institute of Technology and is to teach structural courses for architects. He is a graduate of Pennsylvania State College and the University of Illinois.

William C. Custer has established a new consulting office at 683 Atlantic Avenue, Boston, Mass.

Closing of the engineer research and development laboratories of the Yuma Test Station, Yuma, Ariz., where tests have been made for the past seven years on floating military bridges, has resulted in the transfer of **Lt. Col. Henry E. Helmboldt** to headquarters, First Army at Governor's Island, N.Y.; **George W. Howard,** to Fort Belvoir, Va., to head the newly organized Bridge and Marine Test Branch; **Kennedy K. Harris,** to Fort Belvoir, to head the Bridge Test Section of the Bridge and Marine Test Branch; and **George B. Davis,** to Phoenix, to work on the Veterans' Administration Hospital, now under construction.

Lt. Col. J. P. Campbell, formerly division engineer of the Great Lakes Division of the Corps of Engineers, is now district engineer at Chicago, Ill.

Rear Admiral J. H. Hawley has retired as assistant director of the Coast and Geodetic Survey after a career of 42 years. Admiral Hawley has surveyed and charted coastal waters of the United States, Alaska, and other countries.

Richard Barber, previously airport engineer for the Civil Aeronautics Administration, Seattle, Wash., is now Wenatchee district engineer for the Washington State Highway Department.

Emanuel H. Pearl, until recently public health engineer for the Health Department of Santa Barbara County (California), has been named chief sanitation officer for the department at San Jose. At one time he was affiliated with the Ohio River Stream Pollution Survey.

Robert Sailer, of the Canals Division of the Bureau of Reclamation, Denver, is the recipient of the Superior Accomplishment Award of the Interior Department for his part in the development of a steel-lined concrete pipe for the Soap Lake Siphon. During the ASCE Fall meeting he presented a paper on the subject at the Structural Division session.

Andrew P. Rollins has been appointed to the Texas State Board of Water Engineers for a six year term, having charge of water conservation in the eastern half of the state.

H. F. Sommerschield, for many years structural representative of the Portland Cement Association in Chicago, has opened a structural engineering office there.

For textbooks "that have had a profound influence on the development of young engineers" for a quarter century, **Prof. Fred B. Seely,** of the University of Illinois College of Engineering, was honored by the American Society of Mechanical Engineers during its recent annual meeting with the Worcester Reed Warner Medal given for outstanding contributions to permanent engineering literature. Professor Seely joined the University of Illinois faculty in 1909, and became department head in 1934.

Harry F. Thomson

Harry F. Thomson, formerly president of the General Material Co., St. Louis, Mo., is now assistant to the president of the Materials Service Corp., Chicago, Ill. Mr. Thomson recently completed a term as ASCE Director, during which he served as chairman of the Committee on Publications. He is a past president of the St. Louis Section. Long active in civic affairs, Mr. Thomson has served as president of the St. Louis Chamber of Commerce. He is a retired lieutenant commander of the Civil Engineer Corps Reserve of the Navy.

R. F. Blanks, research division head of the Bureau of Reclamation, Denver, and **Douglas McHenry,** structural research head, are performing work for the Army Corps of Engineers on permeability and uplift pressures in concrete structures. The Corps is sponsoring a testing program aimed at ultimate improvement of design criteria for concrete dams and similar structures. While engaged in work on the program, the Bureau engineers are to be on Army detail.

Alfred Brahdy, head of the Designs Division of the New York City Board of Transportation, has been awarded the 1948 prize of the Municipal Engineers' Society for "the most meritorious paper in promoting engineering knowledge." The paper dealt with the design of bus garages and trolley coach depot for housing and maintaining buses and trolley coaches operated by the Board of Transportation. The prize consisting of a pendant bearing the seal of the Municipal Engineers will be presented at the society's January meeting. Mr. Brahdy was appointed to the Public Service Commission in 1908 and has continued in the transit field since.

James L. Ferebee

James L. Ferebee has retired as chief engineer and general manager of the Milwaukee & Metropolitan Sewerage Commission, and will make his home in Pinehurst, N.C. Mr. Ferebee has been in the employ of the City of Milwaukee most of the time since 1915, and has been chief engineer and general manager since 1930. In 1933 and 1934 he was on leave of absence to serve as state engineer for the PWA. Long active in Society work on both national and Section level, Mr. Ferebee served a term as ASCE Director from 1935 to 1937 and as vice-president in 1939 and 1940. He is a former president of the Wisconsin Section.

Governor Warren of California recently appointed **A. M. Rawn,** of Los Angeles, and **G. E. Arnold,** of San Diego, to the State Water Pollution Board. Other ASCE members named to regional boards in Southern California, include **M. J. Shelton,** San Diego Regional Board; **Horace P. Hinckley,** Santa Ana Regional Board; and **Carl Arnold** and **Ray Derby,** Los Angeles Regional Board.

Mark B. Owen and **Robert L. Meek** have established a consulting office at 1920 North Meridian Street, Indianapolis, Ind.

Michael Yatsko has accepted a position as instructor in civil engineering at the University of Dayton.

Maurice C. Lipp has been transferred from the Bureau of Yards and Docks, Washington, D.C., to the Public Works Department of the Naval Ordnance Test Station at China Lake, Inyokern, Calif.

Russell Culp, who recently resigned as city engineer at Garnatt, Kans., has accepted the post of sanitation engineer with the State Board of Health at Lawrence. He is planning to study for a master's degree there.

G. Donald Kennedy

G. Donald Kennedy, until recently vice-president of the Automotive Safety Foundation in charge of the Highways Division, has accepted the position of consulting engineer and assistant to the president of the Portland Cement Association, Chicago, Ill. In his new capacity he will assist on technical, promotional, and public relations problems involved in the conduct of the Association's program in the United States and Canada.

Bertram H. Lindman, Washington, D.C., consultant, has been retained by the Association of American Railroads. In 1946 he made a study of highway financing for the California legislature.

Malcolm Pirnie, past-president of ASCE and New York City consultant, has been unanimously chosen as 1950 recipient of the Scarsdale Bowl "in recognition of his contribution to civic life in Scarsdale." A resident of Scarsdale for the past 30 years, Mr. Pirnie has served on the Village Board, the Zoning Board of Appeals, and as mayor.

Ralph Parshall, retired irrigation engineer of Fort Collins, Colo., has been awarded the gold medal of the Colorado Engineering Council, a state organization comprised of 19 technical and professional engineering societies. Mr. Parshall was cited for "distinguished service to society and to the engineering profession."

Harry S. Rogers, president of the Polytechnic Institute of Brooklyn, was elected chairman of the Engineers' Council for Professional Development at a recent meeting in Chicago. For his services on the national engineers committee that prepared reports for the State and War Departments on the industrial disarmament of Germany and Japan, Dr. Rogers was awarded the President's Certificate of Merit in 1947.

V. E. Vallet, president of Giffels & Vallet, Inc., L. Rossetti, Detroit, Mich., associated engineers and contractors, announces the formation of a Canadian subsidiary under the name of Giffels & Vallet of Canada, Ltd., with headquarters at Windsor, Ontario.

John W. Shupe recently accepted an appointment to the faculty of the Institute of Transportation and Traffic Engineering of the University of California at Berkeley. He is a civil engineering graduate of Kansas State and has lectured in civil engineering and taught applied mechanics.

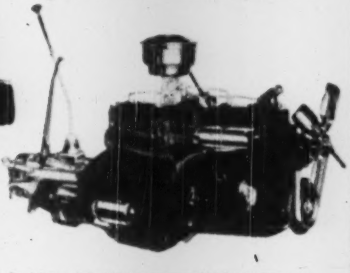
W. E. Blomgren, former assistant director of Region 7 of the Bureau of Reclamation, has assumed new duties as assistant chief engineer of the Bureau with headquarters in Denver.

L. M. Fisher recently resigned from the Public Health Service to become engineering field associate of the American Public Health Association, New York City. Mr. Fisher will direct work toward improvement of the quality of sanitation services in local health departments, a continuation of the Engineering Section Project begun in 1946.

NOW! The most powerful 6-cylinder Ford Truck ever built!

New
ROUGE **254** SIX
ENGINE
FOR THE HEAVY DUTY F-6

Thoroughly Proved in Industrial Engine and Motor Coach Operation



In Ford Series F-6—110 Horsepower, 212 lbs.-ft. Torque
In Ford Series F-6 COE—106 Horsepower, 210 lbs.-ft. Torque

THE NEW FORD 254 ENGINE gives you all these modern design features!

CHROME-PLATED top piston ring for better lubrication, longer cylinder life.

AUTOTHERMIC aluminum alloy pistons with solid skirt. Steel strut controls piston to wall clearance.

HIGH-LIFT camshaft for increased valve opening, greater power.

FREE-TURN exhaust valves. Self-cleaning, better seating, longer-lived.

COBALT-CHROME faced exhaust valves for hard contact surface giving longer wear.

HIGH-TURBULENCE Power Dome combustion chambers for more power, greater economy.

New Ford 110-H.P. engine plus new 4-speed Synchro-Silent transmission make Series F-6 the standout performer in its class!

THE BRAND NEW Rouge 254 Truck Six gives you new power, new performance in the heavy-duty field.

This 254 cu. in. powerhouse gives you the latest engineering ideas. Free-turn, self-cleaning exhaust valves, faced with durable cobalt-chrome alloy. High-lift camshaft for increased valve opening. Chrome-plated top piston ring for longer cylinder wall life.

You get these and many other new features in the new "Rouge 254" available in Ford Model F-6. You get power that makes the F-6 the most powerful 6-cylinder Ford Truck ever built. You get the brand new 4-speed Synchro-Silent transmission. You get Bonus* Built construction which means big reserves of strength and power. See your Ford Dealer. Get all the facts about the new "Rouge 254," the fourth in a great line of Ford Truck engines.

***BONUS:** *"Something given in addition to what is usual or strictly due"—Webster*

Ford Trucks Cost Less because
FORD TRUCKS LAST LONGER

Using latest registration data on 6,106,000 trucks, life insurance experts prove Ford Trucks last longer!

Deceased

Bertram Joseph Ahearn (Assoc. M. '23) section engineer for the New York City Board of Transportation, was fatally stricken in the headquarters of the Board on November 10. His home was in Forest Hills, Queens. Mr. Ahearn, who was 62, had spent his entire career in city service. He was with the Metropolitan Park Commission from 1905 to 1907, and the Board of Water Supply from 1907 to 1926. In the latter year he became connected with the Board of Transportation.

Herman Beal (M. '25) retired civil engineer of Omaha, Nebr., died on October 11, at the age of 87. A long-time resident of Omaha, Mr. Beal was assistant engineer for the city from 1914 to 1921, and city engineer from 1921 until his retirement in 1933. His earlier experience included work for the Burlington & Missouri River Railroad at Omaha, and as engineer for South Omaha and Douglas counties.

Charles Werner Christensen (M. '44) engineer for the U.S. Engineer Office at Davenport, Iowa, died on November 6, at the age of 62. From 1912 to 1931 Mr. Christensen had a private architectural and engineering practice in Chicago, specializing in design and construction of steel and reinforced concrete buildings. Since 1931 he had been in the U.S. Engineer Office—for many years at Rock Island, Ill. Mr. Christensen held engineering and architectural degrees from Chicago Technical College.

Melville Dozier, Jr. (M. '11) of Los Angeles, Calif., died on November 9, at the age of 74. A graduate of the University of California class of 1898, he gained early experience in engineering and administrative work with the electric and interurban railways in the Los Angeles and San Francisco areas. Later he was general manager of the California State Reclamation Board at San Francisco, and manager of the Southern California Chapter of the Associated General Contractors. For some years he had a consulting practice in Los Angeles, and more recently had been executive director and secretary of the Los Angeles County Housing Authority.

Robert Edwin Fristoe (M. '36) assistant general manager of the Galveston Wharves, Galveston, Tex., died at his home there on September 26, 1949, at the age of 58. From 1914 to 1926, Mr. Fristoe was with the Santa Fe Railroad at Galveston, except for leaves of absence to attend the University of Texas and to serve in World War I. Since 1926 he had been with the Galveston Wharves, specializing in structural and foundation design. At one time he was chief engineer. Mr. Fristoe belonged to the American Railway Engineers Association, and was a registered professional engineer in the state of Texas.

Chesleigh Gray (M. '43) president and owner of the Ready Mixed Concrete Corp., Indianapolis, Ind., died suddenly at his home there on November 6. His age was 63. Mr. Gray was a graduate of Rose Polytechnic Institute, and had served on its board of managers since 1935. A specialist in concrete construction, he had been chief engineer of the Indiana State Highway Commission and president of the National Ready Mixed Concrete Association. He was a veteran of World War I, having served overseas as first lieutenant in the Army Air Service.

Chesleigh Gray

Raphael Gay Hosea (M. '28) civil engineer of Pasadena, Calif., died at Balboa, C.Z., on November 20, while returning from a South American cruise. Mr. Hosea, who was 66, retired two years ago as consultant for the U.S. Engineer Department at Los Angeles. He first went to California in 1938 as secretary for the Colorado River Board of California. Earlier he had been for some years engineer for the Middle Rio Grande Conservancy District at Albuquerque, N.Mex. He was a graduate of Massachusetts Institute of Technology, and a member of the Colorado Society of Engineers and Sigma Chi.

Alden Dinsmore Hunting (Assoc. M. '34) member of the Palo Alto, Calif., firm of Hunting & Adamson, died on November 22, at the age of 44. His home was in Redwood City, Calif. From 1928 to 1940 Mr. Hunting was in the bridge department of the California Division of Highways, working during this period as assistant and associate construction engineer on the San Francisco-Oakland Bay Bridge. He then became staff engineer for Donald R. Warren, of Los Angeles, and during the war was in the U.S. Marine Corps.

William Ignatius Klein (M. '16) consulting engineer of East Orange, N.J., died on December 1, at the age of 74. An authority on water purification and sewage treatment, Mr. Klein had advised on projects all over the world, and was consultant on Army and Navy projects in both wars. He had been assistant Engineer in charge of the design and construction of a water-supply improvement for the City of Albany, N.Y., and for a number of years was resident engineer for the New York Continental Jewell Filtration Co. For some years he had a consulting practice in New York.

Norman McLean (Assoc. M. '28) of San Diego, Calif., died recently. He was 49. Mr. McLean had been construction superintendent for the Santa Fe Land Improvement Co., and for some years had a private practice in San Diego, specializing in land subdivison and construction. More recently he was a civil engineer in the Public Works Department of the Navy at San Diego.

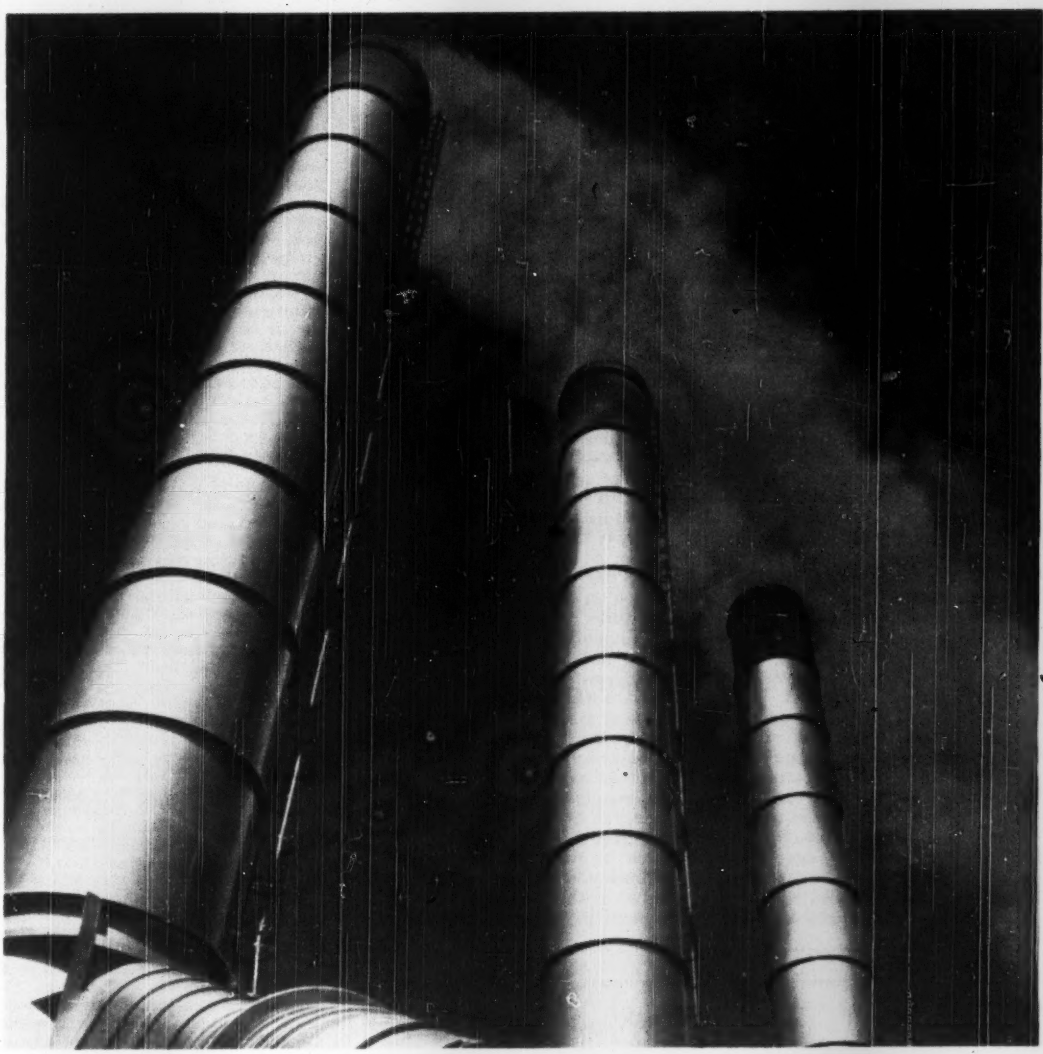
Henry Lanark Miller (Assoc. M. '11) general manager of the Sociedad Real del Padre, Mendoza, Argentine Republic, died there almost a year ago, according to word just received at Society headquarters. He was 72. Though born and educated in the United States, Mr. Miller spent his entire professional career in South America. After a number of years as engineer of roads and bridges for the Department of Public Works of the Province of Mendoza, Mr. Miller became connected with the Sociedad Real del Padre.

Charles Church More (M. '22) professor emeritus of structural engineering at the University of Washington, Seattle, Wash., died at his home there on November 19. He was 74. A member of the university faculty for 43 years, Dr. More retired from active teaching in 1947. He originated new and successful methods of teaching engineering and mathematics, and was held in unusually high regard by generations of engineering students. The new civil engineering building on the university campus was named in his honor, and he was awarded the 1949 Lamme Medal award. Professor More received his civil engineering degree from Layayette College and his master's degree at Cornell. For six years before joining the university faculty he was employed in bridge and construction work.

William Chester Morse (M. '21) superintendent of water for the City of Seattle, Wash., died recently. Mr. Morse, who was 75, devoted his career to Pacific Northwest engineering projects. For a number of years prior to his appointment as superintendent of water in 1940, he maintained a consulting practice in Seattle. Earlier he was engineer for the Puget Sound Bridge & Dredging Co. In World War I, Mr. Morse served as a major in the Artillery Corps in France.

H. Jackson Tippett (M. '27) for the past 15 years secretary of the Connecticut Society of Engineers, New Haven, Conn., died in a hospital there on November 21. He was 68. Mr. Tippett had been employed for a number of years as division engineer for the Connecticut Co., a public transportation utility. Earlier in his career he was in the engineering department of the New York & Stamford Railway, with headquarters at Port Chester, N.Y.

Jack Hennigan Tyler (M. '48) lieutenant colonel, Army Corps of Engineers, died in a swimming pool accident in Washington, D.C., on November 15. Colonel Tyler was 37 years old, and an alumnus of the University of California, class of 1934. After two years of postgraduate work at the University of Southern California, he joined the civilian staff of the Los Angeles office of the Corps of Engineers. Entering active military duty as an Engineer officer in 1942, he served overseas as principal staff officer of a Communications Zone section for three years and participated in the invasion of northern France. He received the European Theater Medal with two bronze stars, and the Bronze Star Medal. For the past three years Colonel Tyler had been in the Civil Works Branch of the Office of the Chief of Engineers. He was a member of Tau Beta Pi and the Society of American Military Engineers.



Three in a row—and a 4th Coming Up

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These three stacks were erected one at a time and the fourth is now being fabricated. Duplicate installations like this are, in effect, a testimonial of our ability to fabricate and erect large steel plate structures.

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Los Angeles 14	1556 General Petroleum Bldg.
New York 6	3395—165 Broadway Bldg.
Philadelphia 3	1652—1700 Walnut St. Bldg.
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Tulsa 3	1647 Hunt Bldg.

Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY and GREENVILLE, PENNA.

Potomac Valley Conservancy District Takes Offensive Against Pollution

(*Continued from page 36*)

Progress in the abatement of pollution has been good throughout the basin even in face of strong competition for funds for other needed improvements. Municipalities, industries and farming interests are footing the bills for the needed facilities. While the Commission as a whole does not favor subsidies, it strongly feels that treatment plants should be given precedence over any other project. Since many other projects are subsidized, the conclusion is obvious.

Every one profits in the abatement of pollution. The states for their small annual investment are receiving direct benefits in the protection of about 240,000 acres of parks and game preserves. The federal government actually owns about 1,000,000 acres in the basin and is making an appropriation of $5,000 a year toward the expenses of the Commission. In view of the many tangible and intangible benefits which accrue to this property, the Commission feels that the Federal Government should match the payment of the states.

The Potomac River Basin has an abundance of good farm land, many undeveloped natural resources, a large potential supply of hydroelectric power and a well developed transportation system, all of which offer excellent opportunities for development and expansion. However, the river must be used wisely and the importance of a planned program for pollution control and the development of the watershed cannot be overemphasized.

The Potomac River has an ability to absorb and purify wastes more than most streams in the United States, but if polluted excessively it may never recover, thus rendering the water forever unsuitable for domestic or industrial purposes.

Fish life would disappear, bathing would become dangerous, boating undesirable and real estate values would decline. The river serves as a waste depository, but this is only one of many uses and should not be given a disproportionate place in the river's use and development. Any program of pollution abatement and control must take into consideration the demand upon the river for the many purposes other than waste disposal and these varying interests must be coordinated to bring about the greatest profit to all from the river's resources.

It is the aim of the Interstate Commission on the Potomac River Basin to consider carefully all the factors involved in pollution control and abatement, and to plan and promote through established state agencies a program which will be an asset to the Potomac Basin as a whole. Such an arrangement is necessary in order to arrive at an equitable distribution of effort and expense. With the continued cooperation of all within the basin, the Commission will be able to accelerate its program of assisting the states in their efforts towards the abatement of pollution and ultimate control of the sanitary quality of the Potomac River and its tributaries.

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American Society of Civil Engineers

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INDEX 1949 CIVIL ENGINEERING (no charge)

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New Publications

Highway Safety. Findings and recommendations of a number of authorities in the field of traffic-accident prevention have been compiled and summarized by the Eno Foundation for Highway Traffic Control in a special 165-page report, entitled *The Motor-Vehicle Driver: His Nature and Improvement.* The contributors—technicians in psychology, safety education, traffic engineering, enforcement, and drivers' licensing—have developed their chapters in terms of important facts in their fields as they relate to driver behavior. Free copies are available to engineers and traffic officials from the Eno Foundation for Highway Traffic Control, Saugatuck, Conn. A special school and college edition may be purchased at 50 cents a copy plus postage from the Center for Safety Education of New York University, 8 Fifth Avenue, New York 11, N.Y.

Public Works. Planning and financing of public works and numerous allied problems, especially those involved in municipal administration, are discussed in the proceedings of the 1949 Public Works Congress, recently released by the American Public Works Association. The 266-page photo-offset bulletin is for sale at $5 a copy from the American Public Works Association, 1313 East Sixtieth Street, Chicago 37, Ill.

Highway Research. To provide a classified listing of highway research projects in progress or recently reported on by state highway departments, federal bureaus, universities, and other agencies, the Highway Research Board has launched publication of a new quarterly entitled *Highway Research Review.* Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, Washington 25, D.C.

Dewatering. Progress made in predraining various types of construction operations all over the country by means of the Moretrench Wellpoint System is described and illustrated in a 64-page catalog issued by the Moretrench Corp. to celebrate its 25th anniversary. Inquiries about the catalog should be addressed to the Moretrench Corp., Engineering and Eastern Division Sales Offices, New York 6, N. Y.

Engineering Research. More than 4,000 current college and university research projects in engineering subjects are listed by title in the 1949 *Review of Current Research,* published by the Engineering College Research Council of the American Society for Engineering Education. Entries in the 180-page volume from 82 educational institutions holding membership in the Council describe their research policies and procedures. Use of the volume is facilitated by a breakdown of research projects according to the engineering departments involved, and by a complete index to subjects. Copies are available at $1.75 each from F. M. Dawson, M. ASCE, chairman of the Engineering College Research Council, College of Engineering, State University of Iowa, Iowa City, Iowa.

(*Continued on page 90*)

Who benefits from Quality Control?

What is Quality Control? What does it do? How does it function? Whom does it benefit?

First and foremost, a quality control operation benefits the customer. It also benefits the manufacturer. It provides assurance to management that the quality level of production is equal to, and generally in excess of, the standard specification.

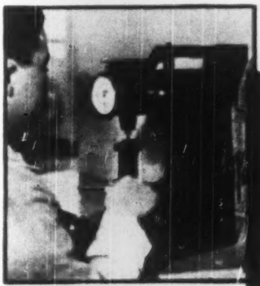
Take us, for example. We manufacture cast iron pressure pipe in accordance with quality control specifications that are more comprehensive and exacting than the accepted technical specifications or customer's specifications under which pipe is purchased.

The first step in Quality Control is that of establishing company standards for both process methods and the physical and chemical properties of the product.

The next, backing-up step is establishing inspection procedures using statistical sampling techniques. These procedures extend from raw materials to finished product.

The final step is to have our Quality Control Dept. establish a group of facts in statistical form and analyze them for the purpose of removing quality standards from the realm of *opinion* into that of *organized facts.*

Production testing laboratories in our various plants are the tools for evaluating these quality standards.



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General Manager of water works; Assoc. M. ASCE; 49; 21 years' experience for a municipality and 2 private companies, in charge of accounting, operation, maintenance, and construction in 7 properties; also a director of the largest property. C-548.

Graduate Civil Engineer, M. ASCE; 26 years' general construction experience as construction superintendent, field layout engineer, or owner's representative on construction of roads, bridges, airports, building construction. Speaks Spanish and German. Will go anywhere. C-549.

Construction Manager, Administrative Assistant; Assoc. M. ASCE; 43; married; graduate engineer with administrative ability and top level experience in layout, design, estimating, and construction of commercial and industrial buildings, including machinery installations; registered professional engineer in California. Available for domestic or foreign assignment. C-550-311-C-5 San Francisco.

Civil Engineer, Jun. ASCE; 25; married; B.C.E.; candidate for M.B.A.; 3 years' diversified engineering experience in both design and drafting; desires employment leading to sales engineer, management engineer, or as assistant to executive; willing to relocate and travel. C-551.

Civil Engineer, B.S. at University of Iowa, February 1950; 23; married; desires design work; 2½ years' experience in architectural and engineering offices. Thorough, conscientious worker. C-552.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient non-profit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Civil Engineer, Jun. ASCE; M.S.C.E., Columbia University; 26; single; engineer-in-training, New York State; Lt. (jg) U.S. Naval Reserve; 4 years' experience, field supervision on airfield work and foundation investigations, office experience in soils laboratory, estimating, design, planning, and assisting structural project engineer on power plant work, and specification writing. Interested in office or field position with construction or structural engineering firm. Location immaterial. C-553.

Civil Engineer, Jun. ASCE; 28; married; B.S. in C.E.; some experience in construction, administration, and teaching; a year's experience in design and layout of structural steel and conveyors for coal preparation plants; desires office or field position in engineering department of industrial company. Location optional. Available on short notice. C-554.

Positions Available

Municipal Engineer, preferably civil graduate, with license, and at least five years' actual experience in municipal public works and engineering, to act as consultant to city officials regarding engineering standards and specifications, analysis of costs, development of standards of performance, determination of equipment needs, and application of approved public works practices generally, including surveys and preparation of reports, manuals, etc., of general use and practical benefit to local municipal officials. Salary, $4,200–$5,000 a year. Location, southern state university. Y-2757.

Assistant or Associate Professor, preferably with advanced degree, to teach fluid mechanics, advanced courses in hydraulic engineering, and assist with research program in hydraulic engineering. Salary, $3,500–$4,500 for nine months. Opportunity for summer teaching or outside work. Location, South. Y-2825.

Sales Engineer, 28–32, civil graduate, with highway and airport construction experience, to promote and supervise the use of asphaltic products. Location, New Jersey. Y-2882.

Editor, under 30, graduate civil engineer, with some experience either on school publication, or preferably with from 1 to 3 years' experience on construction. Location, New York, N.Y. Y-2923.

Sanitary Engineers. (a) Sanitary Engineer, graduate, with 10 to 15 years' experience in water distribution and sewerage systems, waterworks and sewage treatment plants, dams, reservoirs, etc., for consulting engineering firm. Must have construction experience, thorough knowledge of sanitary design and be capable of directing drafting room work. Salary dependent on qualifications. (b) Assistant Sanitary Engineer, graduate, with 3 to 5 years' experience in sewerage systems, waterworks, etc., to direct work of small squad of draftsmen and/or junior engineers in sanitary design. Salary dependent on qualifications. Location, Pennsylvania. Y-2936.

Sales and Contract Engineer, 30–35, civil graduate. Must have had some experience on structural steel, preferably bridge work, and some previous sales experience desirable. Salary, $4,000–$5,000 a year. Location, eastern Pennsylvania. Y-2939.

Civil Engineer, graduate, with at least 12 years' experience, to supervise project engineer on building work, waste disposal, and structural design for chemical company located in the East. Scheduling experience also desirable. Write stating experience, education and salary requirements. Y-2970.

Professor in sanitary engineering, with advanced degrees, to develop sanitary engineering program and to head department of civil engineering. Experience in engineering practice and in research essential. Y-3007.

Assistant Engineer, 30–40, civil graduate, with at least 5 years' experience in municipal design construction and maintenance, to assist resident engineer and manager in charge of utility construction program consisting of telephone system, power plant, water treatment plants, steam, electric, and water distribution systems. Salary, $7,000–$10,000 a year. Location, Alaska. Y-3018.

Civil Engineer, under 40, graduate, with Pennsylvania professional engineering license and concrete engineering experience, to design concrete columns, slabs, etc., prepare specifications covering mixes, settings, etc., supervise material and strength tests, and write reports. Salary open. Location, western Pennsylvania. Y-3028.

General Manager or President for concern manufacturing quarrying, rock-crushing, road construction, and conveying equipment. Should have some background of having worked in the field with this type of equipment. Salary, $20,000–$30,000 a year. Location, East. Y-3040.

Sales Promotional Engineer, 30–35, civil or architectural training, experienced in sale and promotion of building construction materials to architects, engineers, contractors, or other specifying authorities; should be well informed regarding building construction and have promotional ability. Will prepare promotional material, conduct meetings, put on displays, carry on technical correspondence and advise clientele regarding applications of building and acoustical material (roofing, Gypsum, wall board, rock wool). Salary, $4,800–$7,200 a year. Location, Chicago, Ill. R-6087.

Designer, hydroelectric plants, graduate civil engineer, experienced with civil engineering problems involved in hydroelectric design; informed about design of power house, dams, conduits, etc., on concrete and some steel. Will work on board. Salary open. Location, Chicago, Illinois. Y-6090.

Construction Superintendent, civil engineering background, and substantial experience with new construction, remodeling, rebuilding and maintenance of dwellings, commercial and industrial buildings; able to deal with construction, architectural, and maintenance problems, and contact architects, contractors, tradesmen and builders in connection with a real estate mortgage management insurance company division. Some traveling. Salary open. Headquarters, Missouri. R-6094.

Junior Construction Engineer, graduate civil or architectural, 25–35; several years' actual experience with on-the-job construction project work in connection with planning and construction of new manufacturing plant of considerable size and the moving in orderly and efficient manner of all personnel, machinery, processes, offices, etc., to new plant. Will be required to draft in the planning stages, lay out plant, and act as liaison between management, architects, engineers, and construction people. Location, Chicago, Ill. R-6105.

(Continued on page 90)

WANTED

Civil Engineer experienced in reinforcing steel design, detailing and estimating. Serve as assistant to and understudy for aging chief engineer. Good starting salary, bonus, and excellent opportunity for advancement to chief engineer or manager of our engineering products department. All replies confidential.

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SPEEDS — four forward 2.40 to 18.61 m. p. h., reverse to 2.37

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Plus special attachments that widen its usefulness — Rear-End Loader, Scarifier, V-Type Snowplow with interchangeable blade for backfilling and light 'dozer work. Also various other accessories, including All-View Cab that is lifted off or replaced in a jiffy.

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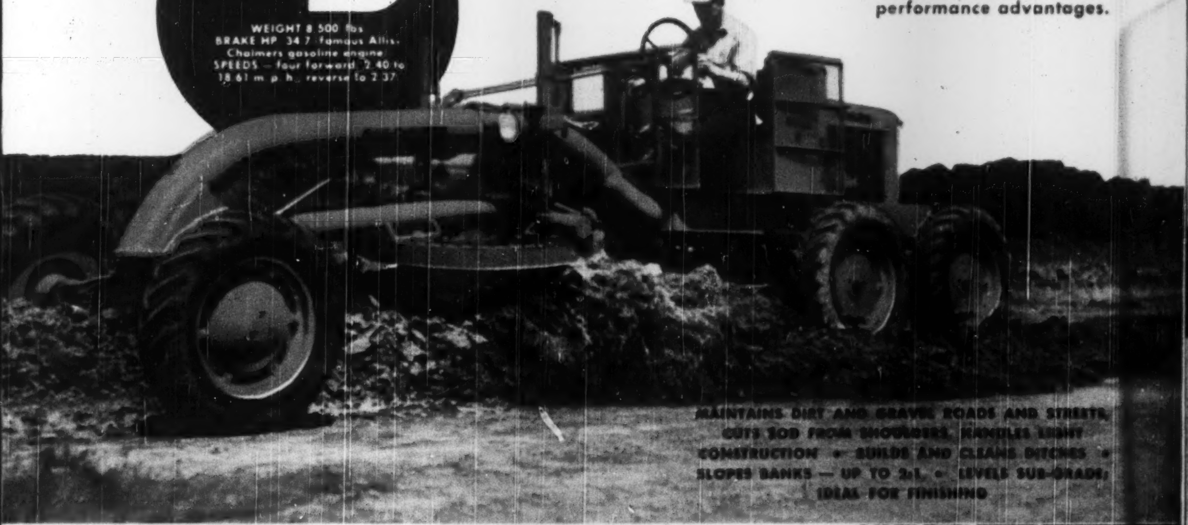

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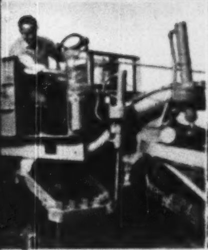

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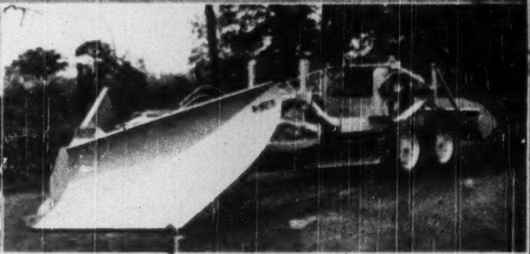
LOADS MATERIAL into trucks with Tractomotive Loader — from windrows and stockpiles ... surplus dirt or snow.



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ALLIS-CHALMERS

TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

(Continued from page 88)

Structural Engineer, up to 50 years of age, Illinois License, substantial experience with industrial type buildings; prefer engineers previously engaged for government work for a consulting engineer. Salary open. Location, Chicago, Ill. R-6127.

Engineers. (a) Project Engineer; minimum 4 years' experience as registered professional engineer or equivalent (good knowledge of C.E. principles and practices in public works, skill in application to problems of design and construction). Will represent city on construction projects, supervise surveys, drafting plans, prepare cost estimates, compile data for checking reports for a bureau of sewers. Salary, $4,320-$4,580 a year. (b) Project Resident Engineer; minimum 7 years' experience as registered professional engineer; advanced knowledge of C.E. principles and practices in public works, skill in application to problems, design and construction. Will serve as second in charge of a city bureau representing city as resident on major construction projects, supervise special surveys, supervise drafting, plans, and preparation of estimates, compile data for technical reports and preparing same, checking plans and preparing specifications for a city bureau of sewers. Salary, $4,864-$5,184 a year. Location, Ohio. R-6128.

Structural Draftsman (steel), under 40; minimum 5 years' experience with structural drafting; bridge or heavy structural drafting experience desirable. Should be able to assist in structural computations and design. Salary, $5,100-$5,400 a year. Location, Chicago, Ill. R-6130.

Assistant Chief Engineer (construction); M.E. or C.E. graduate about 33; several years' experience with cement pouring, steel construction and erection of structures. Will plan and supervise construction of foundations, dams, cement pouring and stream-pollution controls for a mining company. Salary, $5,000-$6,000 a year. Location, Florida. R-6133.

New Publications

(Continued from page 86)

Army Construction Program. To keep the construction industry informed of its proposed construction schedule, the Ohio River Division of the Corps of Engineers has made available in printed form its program for 1950. The publication lists all Division Projects on which bids will be received through the fiscal year June 1950 and a brief description of the work involved, together with approximate quantities. Full information is available from either the Pittsburgh, Huntington, or Louisville District offices of the Corps of Engineers.

Sedimentation. To meet the need for an inventory of sediment-load data on streams in the United States, the Soil Conservation Service has issued Sedimentation Bulletin No. 1. Compiled under the auspices of the Subcommittee on Sedimentation of the Federal Inter-Agency River Basin Committee, the 82-page bulletin gives both published and unpublished material on sedimentation. Copies are available for limited distribution at the Washington office of each of the agencies represented on the Subcommittee on Sedimentation: U.S. Forest Service; Corps of Engineers; Coast and Geodetic Survey; Bureau of Reclamation; Geological Survey; Office of Land Utilization; Federal Power Commission; and Tennessee Valley Authority.

Runoff. Climatologic, geologic, and topographic factors responsible for runoff occurrence in the United States are summarized in Geological Survey Circular 52, entitled *Annual Runoff in the United States.* A two-color map of the United States showing isograms of runoff is included in the report, which was written by Walter B. Langbein, Assoc. M. ASCE, and others. Free copies are available on application to the Director, Geological Survey, Washington 25, D.C.

Hydraulic Research. Recent technical publications prepared at the St. Anthony Falls Hydraulic Laboratory at the University of Minnesota include Bulletin No. 1, entitled *Hydraulics of Conduit Bends*, by Alvin G. Anderson, Assoc. M. ASCE (50 cents); Bulletin No. 2, *Grate Inlets for Surface Drainage of Streets and Highways*, by Curtis L. Larson (60 cents); Circular No. 2, entitled *The Pitot Cylinder*, by Edward Silberman, Assoc. M. ASCE (no charge); Circular No. 4, *Use of Models in Planning Water Control Works*, by Lorenz G. Straub, M. ASCE, director (no charge); and Technical Paper No. 1, Series B, on *Air Bubble Resorption*, By Edward Silberman (20 cents). Other available publications and films prepared at the St. Anthony Falls Laboratory, are listed in Circular No. 3, for which there is no charge. Requests should be addressed to: The Director, St. Anthony Falls Hydraulic Laboratory, Hennepin Island, Minneapolis 14, Minn. Checks and money orders are payable to the University of Minnesota.

Hydraulics of Flow. Investigations of the influence of random roughness on flow in pipes are described in Bulletin No. 115 of the University of Washington Engineering Experiment Station. Author of the report is Charles W. Harris, M. ASCE, professor of hydraulic engineering at the university. Inquiries should be addressed to the University of Washington Engineering Experiment Station.

Aerial Photography. Some of the methods and advantages of aerial mapping are explained in an illustrated brochure, *Wings for the Transit*, prepared by the Photogrammetric Division of Lockwood, Kessler & Bartlett, Inc. Included in the publication are examples of stereoscopic pairs, mosaics, and photogrammetric maps drawn with the aid of precise stereo-plotting instruments. Copies of the booklet may be obtained from Lockwood, Kessler, & Bartlett, Inc., 32 Court Street, Brooklyn, N.Y.

Slag. A comprehensive summary of the production, processing, and uses of iron blast-furnace slag, which is widely employed in road construction, for railroad ballast, and as aggregate in concrete, has been compiled by the U.S. Bureau of Mines and issued as Bulletin 479. Copies of the bulletin, which is entitled *Iron Blast Furnace Slag: Production, Processing, Properties, and Uses*, may be obtained only from the Superintendent of Documents, Government Printing Office, Washington 25, D.C., for 75 cents each (paper covers). Single copies, in special bound buckram covers, are available (as long as the supply lasts) to interested persons, upon request to the National Slag Association, 644 Warner Building, Washington 4, D.C.

Highways. Availability of a limited number of copies of the Proceedings of the American Association of State Highway Officials, covering committee activities in connection with the Salt Lake City meeting in September 1948, has been announced by the AASHO. Copies are $4 each, and checks should be made out to the AASHO, 1220 National Press Building, Washington 4, D.C.

Building Codes. Individuals or organizations responsible for the preparation or revision of building codes will find much valuable information in a new booklet, *Preparation and Revision of Building Codes*, recently published by the National Bureau of Standards. Copies, consisting of 17 large-size pages, are being sold by the Superintendent of Documents, Government Printing Office, Washington 25, D.C., at 15 cents apiece. Remittances from foreign countries must be in U.S. exchange and must include an additional sum of one-third the publication price to cover mailing costs.

Hydraulic Research. Issuance of technical memoranda, reporting several recent model investigations conducted by the Waterways Experiment Station, has been announced by the Corps of Engineers. These are Technical Memoranda No. 2-300, entitled *Method of Operation of the Birds Point—New Madrid Floodway, Missouri;* No. 2-301, on *Wave and Surge Action, Monterey Harbor, Monterey, California;* and No. 2-302, dealing with *Flood Control Conduits for Detroit Dam, North Santiam River, Oregon.* All three sell for $1 each, upon application to the Waterways Experiment Station, Vicksburg, Miss.

Technical Style. To help bring about greater uniformity in style, format, and presentation of technical data, the American Standards Association has issued a revised and enlarged edition of its *Style Manual for American Standards.* Members of editing committees will find the 28-page publication especially useful in the writing of standards. Free copies will be available to the chairmen or secretaries of such committees, upon application to the American Standards Association, Inc., 70 East 45th Street, New York 17, N.Y. To others the price ranges from $1 for single copies to 50 cents a copy in lots of over 500.

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California Builds Wider, Safer Highway on Ridge Route

(Continued from page 46)

fifth contract, awarded June 24, 1948, to N. M. Ball Sons, for 3.3 miles from Pico Canyon Road to Saugus Road, was completed April 8, 1949, at a cost of $450,600.

Work is now in progress on the sixth contract from Los Alamos Creek to a point 2.3 miles south of Route 59. This contract, awarded to Peter Kiewit Sons' Co. on April 14, 1949, for 6.7 miles of reconstruction, is estimated to cost about $925,000. Because of the excellent progress being made, completion is now anticipated by the end of 1949. With the completion of this contract 23.4 miles of the total 44-mile length of the Ridge Route in Los Angeles County will have been reconstructed, or a little more than half.

Plans are proceeding rapidly for the reconstruction and widening of the remaining sections, and it is expected that a four-lane divided roadway, developed for the most part on a limited-access freeway basis, will be completed for the entire 44 miles of the Ridge Route within the next few years.

As above described, the Ridge Route is one of the most important traffic arteries on the State Highway System.

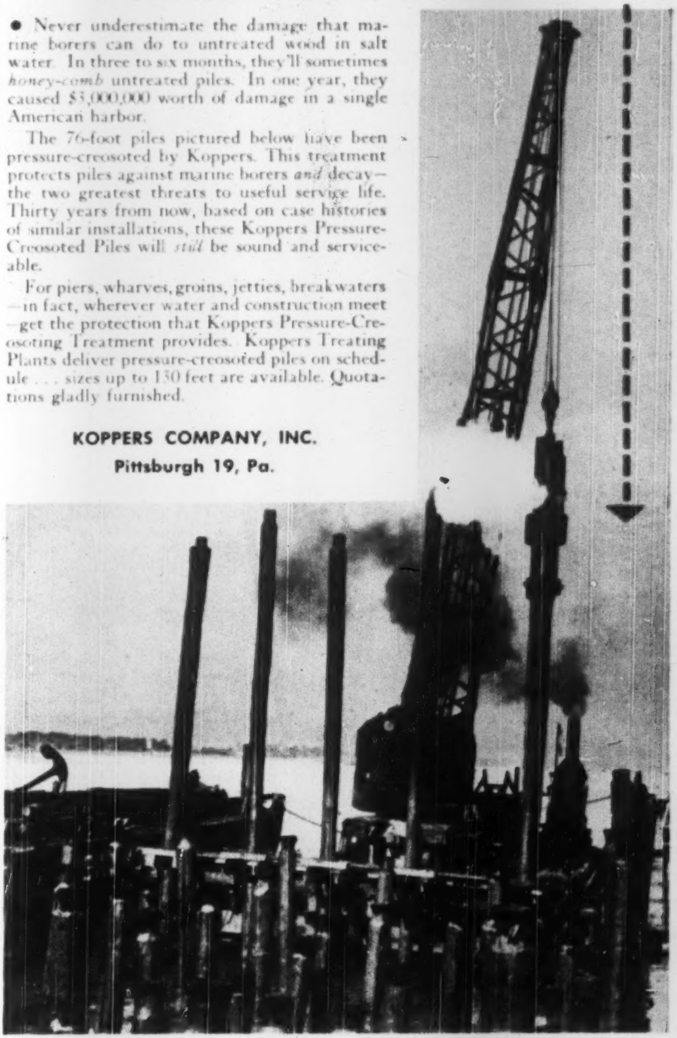
C. H. Purcell, M. ASCE, is the State Director of Public Works and ex-officio chairman of the California Highway Commission. George T. McCoy, M. ASCE, is State Highway Engineer at Sacramento. The state highway work in the Los Angeles District (District VII) is under the general supervision of the writer and the District Engineers, P. O. Harding, M. E. Cessna and W. L. Fahey, with offices in Los Angeles.

Positions Announced

U.S. Civil Service Commission. Applications are being accepted for the position of highway engineer trainee with the Bureau of Public Roads, for on-the-job training during the summer months and for scholastic training in civil engineering during the regular session at college or university designated by the BPR, with a yearly pay rate ranging from $2,650 to $3,100. Applications are also being accepted for the positions of highway engineer and highway bridge engineer, full-time duty ($3,825) for the Bureau of Public Roads and other federal agencies. Applications for these examinations must be filed with the Commission's Washington office not later than February 8, 1950.

U.S. Civil Service Commission. Announcement of examinations is being made for the following positions: engineer ($3,100-$3,825); civil engineer trainee ($2,650-$2,875) and junior scientist (chemist, physicist, metallurgist) and engineer ($2,650-$3,825). Applications will be accepted from college students expecting to complete required courses of study by June 30, 1950. The engineer and civil engineer trainee jobs are in the Bureau of Reclamation in several Western states; and the junior scientist and engineer jobs will be filled in various federal agencies in Washington, D.C., and its vicinity and Ohio. Application forms for these examinations can be obtained at local post offices, Civil Service regional offices, or from the U.S. Civil Service Commission, Washington 25, D.C.

U.S. Department of the Interior. The National Park Service is inviting applications from college graduates in civil engineering for a temporary position as engineer in the Grand Canyon National Park, with duration of employment depending on the establishment of a Civil Service Engineering (Civil) Register in the region. Starting salary at $3,100. Applications and details can be obtained from the Grand Canyon National Park, Grand Canyon, Ariz.



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- Never underestimate the damage that marine borers can do to untreated wood in salt water. In three to six months, they'll sometimes *honey-comb* untreated piles. In one year, they caused $3,000,000 worth of damage in a single American harbor.

The 76-foot piles pictured below have been pressure-creosoted by Koppers. This treatment protects piles against marine borers *and* decay—the two greatest threats to useful service life. Thirty years from now, based on case histories of similar installations, these Koppers Pressure-Creosoted Piles will *still* be sound and serviceable.

For piers, wharves, groins, jetties, breakwaters—in fact, wherever water and construction meet—get the protection that Koppers Pressure-Creosoting Treatment provides. Koppers Treating Plants deliver pressure-creosoted piles on schedule . . . sizes up to 130 feet are available. Quotations gladly furnished.

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Foundation piles being driven for the 150-foot extension of the U. S. Coast Guard pier at Charleston, S. C.

KOPPERS PRESSURE-TREATED WOOD

Remedies for Oilfield Subsidence Considered

(*Continued from page 55*)

reductions in production for many months since September 1948 have not been accompanied by a change in the subsidence rate. In many parts of the field the rate had leveled off prior to September 1948 and the September episode has not altered the general picture. Still greater curtailment might however have far-reaching results on the amount of ultimate subsidence.

While Commander Coxe indicates that reduced production cannot be expected to stop subsidence, but that slowing down the rate of subsidence might provide more time for study of methods of water repressuring, the writer is more inclined to reverse the values because of the evidence of edgewater action. Appreciable control of subsidence by water repressuring is probably not feasible, either economically or physically, but sufficient control of production might be expected to reduce the ultimate magnitude of subsidence if practiced at the proper time. The proper time may or may not already be past.

It has been suggested that effective repressuring could be accomplished with one hundred wells, dispersed generally around the perimeter of the field so as to do a minimum of damage to producing oil wells. This is impracticable because of inaccessibility of offshore sites for such wells on half the field.

A base figure of $323,000,000 is estimated by petroleum engineers in the field as the probable cost of a complete and sound pressure maintenance program, with no assurance whatever that it would serve the desired purpose of stopping subsidence. The economics would be doubtful. Ninety percent of total subsidence is expected within the next five years. The estimate of time for accomplishing even a skeleton effort at pressure maintenance is about five years, and the average pressure drawdowns in the oil sands—the postulated source of the subsidence—have already exceeded 60 percent.

ROBERT R. SHOEMAKER, M. ASCE
Chief Harbor Engineer
Board of Harbor Commissioners
Long Beach, Calif.

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Recent BOOKS

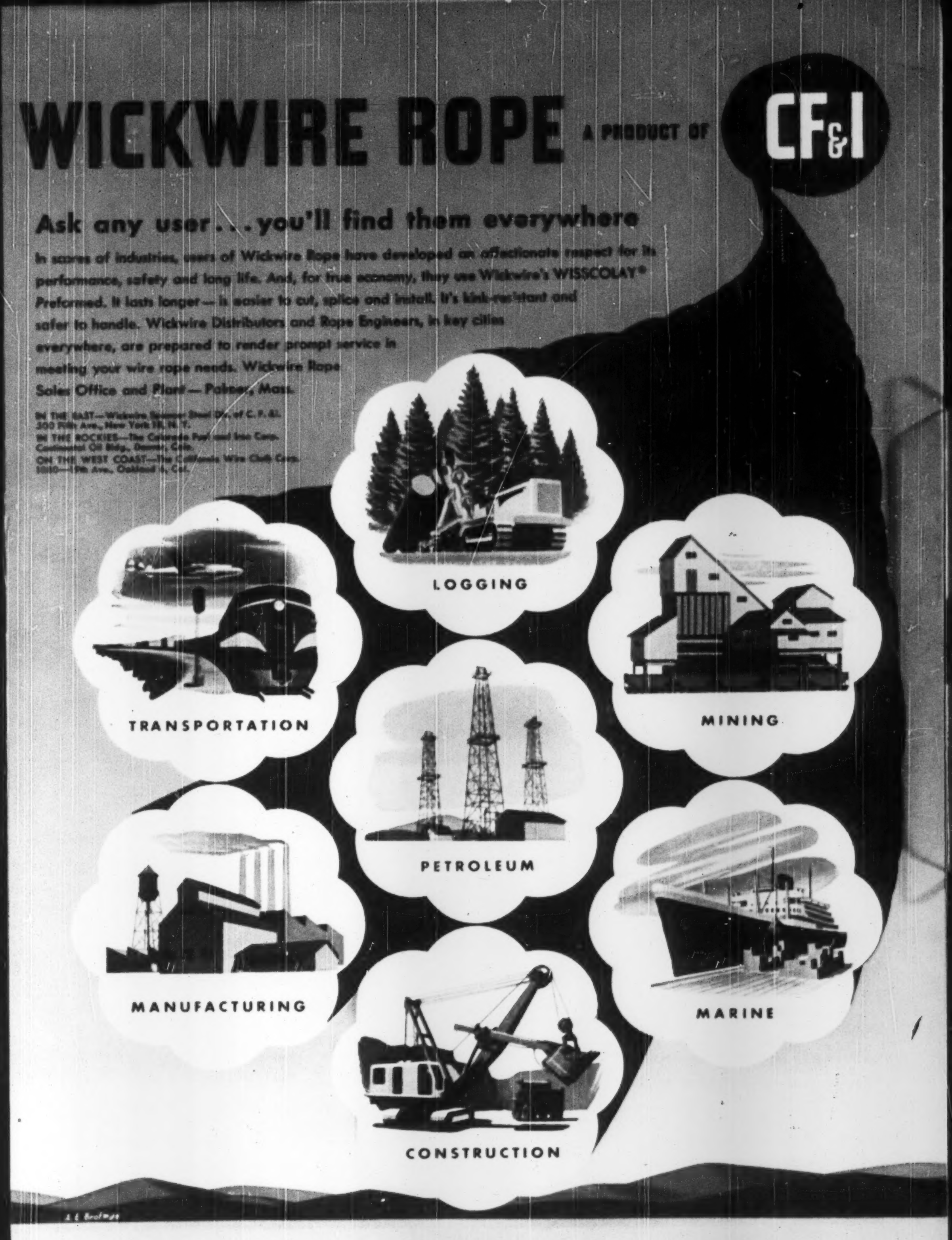
BARRAGES ET CANALIZATION. By J. Aubert. Dunod, 92 Rue Bonaparte (VI), Paris, 1949. 558 pp., illus., diagrs., charts, maps, tables, $11 \times 7^{1}/_{2}$ in., cloth, 3200 frs. Dealing particularly with the problem of the canalization of rivers, this treatise devotes the major amount of space to detailed description of the various types of movable dams which are employed for that purpose. General aspects and a brief treatment of fixed dams precede the main section. Following the main section are chapters on the utilization of dams and locks for canalization and descriptions of a number of major projects in various parts of the world.

CHEMICAL ENGINEERING PLANT DESIGN. 3 ed. By F. C. Vilbrandt. McGraw-Hill Book Co., New York, Toronto, London, 1949. 608 pp., diagrs., charts, maps, tables, $9^{1}/_{4} \times 6$ in., cloth, $6. This book deals strictly with plant design and considers equipment only with relation to the main subject. In this third edition, extensive revisions bring the material up to date and include data on the capacities of new equipment, on new products, and on new techniques. Noteworthy features include the expansion of the chapter on preconstruction cost estimating, information dealing with cost indexes, new material on pilot plants, more projects, and more detailed procedures.

MEMENTO DE POCHE ET CLÉ UNIVERSELLE DE CONVERSION DES UNITÉS ELECTRIQUES ET MÉCANIQUES GIORGI (M.K.S.A.). By M. Denis-Papin and A. Kaufmann. Éditions Desforges, 29 Quai des Grands-Augustins, Paris (6^e), 1949. 48 pp., tables, $6^{1}/_{4} \times 4^{1}/_{4}$ in., leather, 300 frs. This small book discusses the derivation and merits of the Giorgi system of units, based on the meter, kilogram mass, second, and ampere (M.K.S.A.). Its advantages as compared to other systems are demonstrated, and a universal key is provided which allows the conversion of units from one system to another.

TECHNICAL DRAWING. 3 ed. By F. E. Giesecke, A. Mitchell, and H. C. Spencer. Macmillan Co., New York, 1949. 851 pp., illus., diagrs., charts, tables, $9^{1}/_{2} \times 6^{1}/_{4}$ in., cloth, $4.50. Intended as a class text and reference book in technical drawing, this volume contains a large number of problems covering every phase of the subject. It uses the "language of the engineer" and includes

(*Continued on page 95*)



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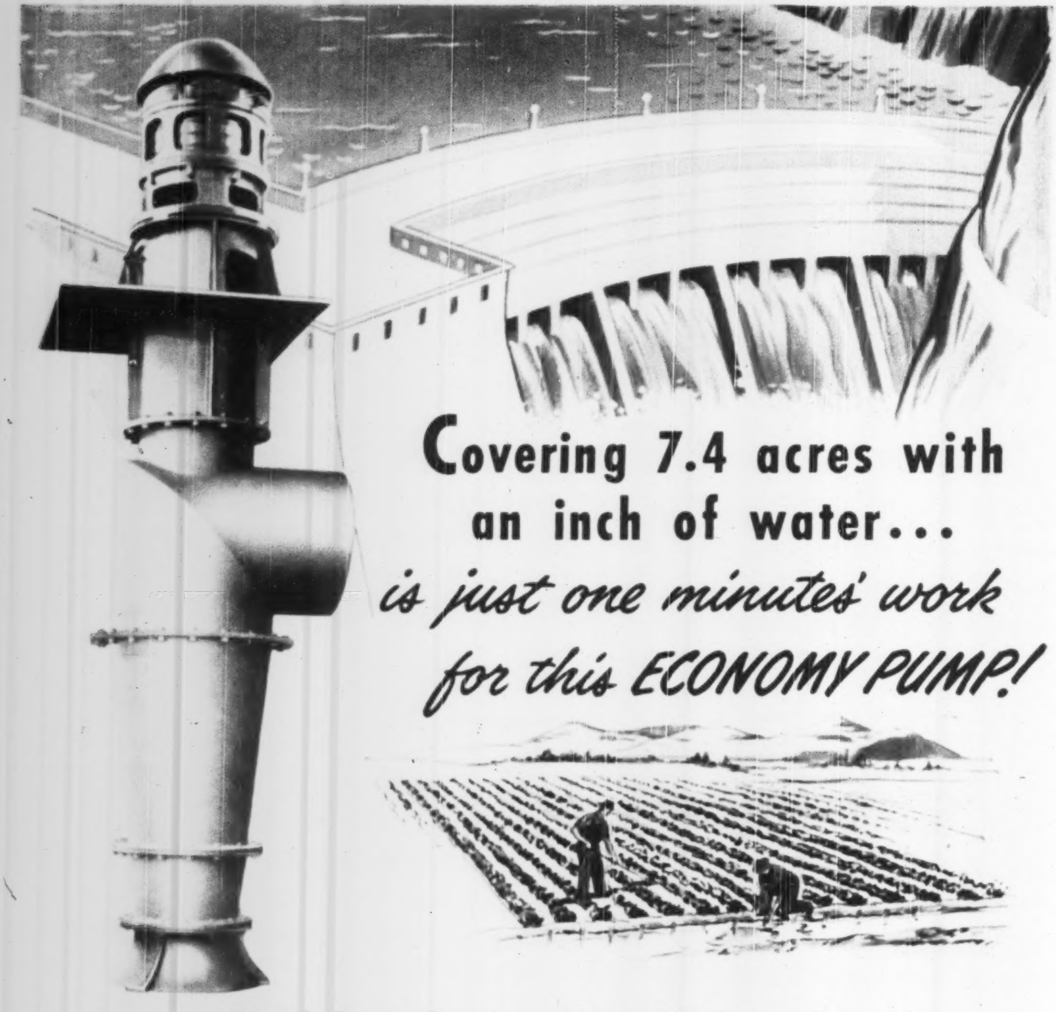

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Economy Pumps Inc.

DIVISION OF HAMILTON-THOMAS CORP. HAMILTON, OHIO

(*Continued from page 92*)

the latest developments in industry. In this edition, a large part of the text matter is rewritten, and a number of new illustrations and problems are added. The book has been brought into agreement with the latest standards of the American Standards Association.

STRUCTURAL ANALYSIS BY MOMENT DISTRIBUTION. By S. Butterworth. Longmans, Green & Co., London, New York, Toronto, 1949. 119 pp., diagrs., tables, 8¾ × 5½ in., cloth, $2.75. This book offers a comprehensive study of the analysis of structures, from continuous beams consisting of two spans to frames of several members. Structures with and without side-sway are considered. There are numerous diagrams of structures with their complete solution.

TECHNOLOGY OF ALUMINUM AND ITS ALLOYS. By A. von Zeerleder, translated from the third German edition by J. J. Stevens. High Duty Alloys Ltd., Slough, Bucks, England, 1948. 451 pp., illus., diagrs., tables, charts, 9¼ × 6 in., cloth, 21s. This book is an English translation of the third German edition. Some two-thirds of the text is revised, and the new material added covers recent developments and knowledge. The list of German patents in the original third edition is omitted, but the bibliography is included with all foreign titles translated.

THEORY OF MODERN STEEL STRUCTURES, Volume I: Statically Determinate Structures. Rev. ed. By L. E. Grinter. Macmillan Co., New York, 1949. 341 pp., illus., diagrs., charts, tables, 9½ × 6¼ in., cloth, $5. Intended as a text for undergraduate courses in the analysis of statically determinate structures, this book studies the basic problems of stress analysis by relating them to specific types of structures. In this second edition, the text is reorganized with considerable revision for clarity and to include modern practices and procedures. The chapter on the basic theories of stress analysis is extended, and more attention is given to flat-roofed buildings.

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G.W. & A. Railroad Relocated Through Allatoona Reservoir

(*Continued from page 32*)

custodian of the state's railroad. Negotiations with the Corps of Engineers leading to the final agreement were conducted by the late R. L. Schmid, M. ASCE, Chief Engineer of the N.C. & St. L. Railway, and the late Otto Joslin, Senior Assistant Engineer. Construction of the project was supervised by J. C. Aker, Chief Engineer; the late R. W. Mabe, Assistant Chief Engineer; and F. A. Patton, Resident Engineer.

The track was built by the Construction Department of the N.C. & St. L. Railway, using all new materials, 132-lb rail, new ties and limestone ballast.

Grading and Bridge Substructure

Oman Construction Co. of Nashville, Tenn., was the successful bidder on both the grading and bridge substructure. Work was commenced in July 1948 and was completed in June 1949, despite a very unfavorable winter and spring for earthmoving. The superstructure of the Allatoona Creek bridge was fabricated and erected by the Virginia Bridge Co. of Roanoke, Va.

The engineers with the N.C. & St. L. Railway who have been connected with this realignment project are justly proud of it, and firmly believe that time will prove it a job well done.

VIBER VIBRATORS
specified for the largest projects in the world...

MODEL E — ELECTRIC VIBRATOR

THE specification by engineers and contractors for Viber Vibrators and recommendation by construction men is mounting evidence of their efficient, economical service.

RESEARCH DEVELOPS NEW METHODS....

A far-reaching program of research has made Viber a leader in the development and application of modern methods of concrete compaction.

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Please write for illustrative catalog on complete line of Viber equipment.

EQUIPMENT, MATERIALS *and Methods*

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

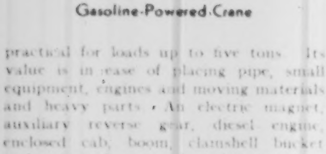
Rubber Springs

RUBBER SPRINGS WHICH TAKE the "jerks" and "bumps" out of riding a tractor have been developed. These springs operate on a torsional shear principle. They consist of a thick layer of especially compounded rubber sandwiched between two metal plates. The rubber is fastened to metal by a special brass-plating process. The springs are mounted in pairs on a new tractor seat now being produced. As the tractor rides over rough ground, the rubber twists and turns with each bump and jolt, cushioning the initial shock and leveling out the sharp rebound which normally occurs with the use of a heavy steel spring. This cushioning effect gives the operator a "floating" ride which lessens body fatigue and helps prevent internal injury from heavy shocks. The springs can be adjusted for various weights from a 100-lb farm girl to a "husky" driver weighing 275 lb. **Public Relations Dept., U.S. Rubber Co., Rockefeller Center, New York 20, N.Y.**

◆

Krane Kar

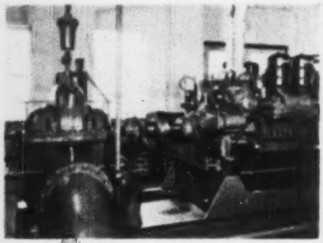
THE DESIGN AND CONSTRUCTION of the Krane Kar combines the safety, ease of operation and fine control of an electric crane, with the high speed, low cost and ruggedness of a gasoline machine. The low headroom and short turning radius makes it ideal for use as an auxiliary crane in the construction field. It is practical for loads up to five tons. Its value is in ease of placing pipe, small equipment, engines and moving materials and heavy parts. An electric magnet, auxiliary reverse gear, diesel engine, enclosed cab, boom, clamshell bucket and a snow plow are a few of the valuable accessories available for the Krane Kar. For further detailed information, pictures, diagrams and specifications, write for Catalog No. 58. **Silent Hoist & Crane Co., Inc., 841-877 63rd St., Brooklyn 20, N.Y.**



Gasoline-Powered Crane

Diesel Engines

THE FAVORABLE ACCEPTANCE OF modern diesel engines for standby and auxiliary power in municipal water systems is due in part to the important savings in space and installation costs that can be effected through their use. As an example of size in relation to power, Twin-Six diesel unit which is 93 in. in length, 56 in. wide and 58 in. high, and yet provides emergency pumping power for the entire city of Beaumont, Tex., with a population of 59,000. Important considerations in the selection of this engine were the limited space available and the fact that no extensive foundations were required. Another such unit is in the main pumping station of the St. Louis County (Mo.) Water Co. It is used only as a standby unit and for periods of peak loads and is capable of pumping 463,000 gal of water per hr with a Worthington "250" pump. Three single six diesels were recently installed by the water department of Pontiac, Mich. The diesel engines on these units occupy a floor space of only 64 × 32 in. each and yet the three units driving Peerless pumps are capable of producing 9,720,000 gal of water a day. **Detroit Diesel Engine Div., General Motors Corp., Detroit 28, Mich.**



Twin-Six Diesel Unit

◆

Crushing Plant

DESIGNED FOR USE in the Philippine Islands for the Abra Provincial Department of Roads to move over light roads and bridges on road building projects, a light-weight portable secondary crushing plant is helping the expansion of the Philippine highway system. The size of the material produced by this particular plant is $^3/_{16}$, $^3/_8$ and $^3/_4$ in. The power unit develops 55 hp and is equipped with electric starting equipment. In spite of the compact 25,000 lb light weight of the unit it is capable of turning out more than sufficient capacities to meet the needs of the Department of Roads. **Lippmann Engineering Works, 4603 West Mitchell St., Milwaukee 14, Wis.**

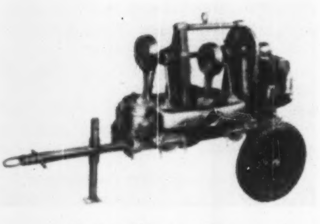
Chain Saw

ONE MAN CAN EASILY handle the new Model 3-25 gasoline-powered chain saw. Total weight of the complete saw, including blade and chain, is only 25 lb, yet it develops a full 3 hp. This unique combination of power and light weight should make the McCulloch a welcome tool for all types of heavy timber work or land clearing. Since this saw will operate at full power in any position or at any angle, and because it is so light in weight, it is an ideal unit for work up in a tree, as well as on the ground. Moreover, its portability lessens the time and labor formerly necessary to maintain or remove trees at locations that are difficult to reach. The power unit is a special single-cylinder, two-cycle, air-cooled gasoline engine, built almost entirely of high-strength magnesium-alloy die-castings. The cylinder, however, is an aluminum die-casting, with a long-life, cast-iron liner. The carburetor is a new diaphragm type, without float. In combination with the built-in fuel pump, this permits use of the saw in all angles and positions. All bearings are anti-friction type. Various chains are available for most efficient cutting in all types of soft, hard or frozen wood. **McCulloch Motors Corp., Los Angeles, Calif.**

◆

Double Diaphragm Pump

MANUFACTURE OF A NEW double diaphragm pump has recently been announced. Engineering, design and construction of the new pump closely parallel that of the company's well-known single diaphragm model which has proved so successful in de-watering operations handled by public utilities, maintenance and construction crews. Like the single diaphragm pump, the new model handles muddy, or sand and debris-laden, water. However, since one diaphragm is always pumping while the other is discharging, there is a constant flow which doubles the new pump's capacity. Complete specifications are available on request. **Novo Engine Co., Lansing, Mich.**



Features Constant Flow

Equipment, Materials & Methods (Continued)

Ductile Cast Iron

INDUSTRY NOW HAS AVAILABLE to it a new cast iron which, unlike ordinary cast iron, is not brittle but can be bent or twisted. This astounding new material can be made readily and economically and can be used in a myriad of applications, thus affording countless economies throughout the industrial world. The novel product, popularly known as ductile cast iron, has several times greater strength than ordinary cast iron with greatly increased ductility and shock resistance. The potential applications are many and varied. The automotive, agricultural implement, machinery, oil, railroad and many other industries can apply it in component parts too numerous to detail. Many new fields will be opened up by ductile cast iron because of its excellent engineering properties, and it will assume an important role in industry. Ductile cast iron combines processing advantages of cast iron, such as fluidity, castability and machinability, with many of the product advantages of steel. The essential feature of the inventions is the introduction into and retention by the molten iron under treatment of a small but effective amount of magnesium. More than 40 companies in many industries are now licensed under the patents to produce this cast iron development. The inventions are being protected patent-wise in all important countries of the world, as it is expected that the inventions will be adopted on a world-wide scale. **International Nickel Co., Inc., 67 Wall St., New York 5, N.Y.**

◆

Compressors

A NEW LINE OF CUSTOM-BUILT, heavy-duty compressors, known as Air Chief AIRistocrats, have been manufactured. These compressors are manufactured on special order for users who demand the absolute best in compressor equipment. Production of the custom-built units will be limited to 100 per year in 105 and 210 cfm sizes and 50 per year in 160 and 315 cfm capacities. As its main line, the company will continue to promote and sell its standard Air Chief which is competitive with compressors of other manufacturers. AIRistocrat features include an extra heavy welded steel, vibrationless frame; electric starting; fenders; locking gas cap; hand parking brakes and electric service brakes. The latter can be connected to the braking system of any vehicle used to tow the compressor. Large hood-protected, locking tool boxes are located on each side of the trailer. An additional tool compartment at the rear carries steels up to 10 ft in length, suspending them beneath the compressor on specially designed brackets integral with the frame. The Model 105 AIRistocrat delivers 105 cfm per min at 100 lb pressure. It is 124 in. long, 66 in. wide and 68 in. high. Weight is 4100 lb. **Davey Compressor Co., Kent, Ohio.**

NEW SURVEYING MICRO Altimeter

Graduations:
ONE FOOT
Range:
6,000 FEET

Another FIRST by the makers of the established world standard in accuracy and dependability . . . the new Surveying MICRO Altimeter for all field and mine ventilation surveys . . . Constructed for lifetime service of finest materials to highest standards . . . exclusive friction-free, zero-gauging principle. Equipped with rugged leather carrying case, magnifier, thermometer and operational procedures.

Model M 1 illustrated . . . other models available . . . see your dealer or write direct.

SURVEYING MICRO ALTIMETER

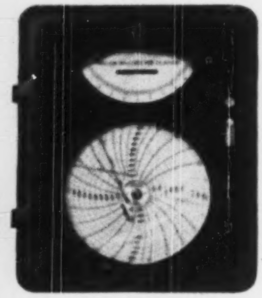
AMERICAN PAULIN SYSTEM
1847 S. Flower Street, Los Angeles 15, California

Plastic Pipe

CARLON "EF," a new plastic pipe which has been developed especially to handle water intended for human consumption, is now available. This new extruded plastic pipe is particularly suitable for piping jet wells, transmitting drinking water in municipal water systems and watering livestock. It has many other diversified applications. It can be used for the transmission of natural or artificial gases, plating tank solutions, chemicals (cold), domestic and industrial sewage, corrosive gases and for radiant heating coils. This pipe also has application in land drainage systems. Carlon "EF" is extruded from a specially compounded organic plastic. While its tensile strength is not as great as that of metallic pipe, it is more than sufficient for normal applications. It is practically unbreakable and its impact at temperatures ranging from 50 to 140 deg F is similar to that of soft rubber. In addition, this plastic pipe has excellent resistance to chemicals and sunlight, and it has a projected service life many times that of metallic pipe. The outstanding features of plastic pipe are light weight, flexibility, corrosion resistance and long service life. Long sections of Carlon "EF" can be handled easily and quickly by one man, who can lay the pipe and then make joints in as little time as 2 min. **Carter Products Corp., 10241 Meech Ave., Cleveland 5, Ohio.**

Simplex narrows the gap of error

With New TYPE "H" METER



An extremely accurate meter which measures flows within ± 2% over a 13 to 1 range!

We feel that a discerning engineer requires accuracy above all else in any instrument he purchases. Within its flow range the new Type "H" Meter registers measurements that are more accurate than usually encountered in commercial instrumentation and it truly "narrows the gap of error".

Type "H" Meter is specially designed for:

- **Use with Venturi Tube, Flow Nozzle, or Orifice Plate.**
- **Measurement of hot or cold water, steam, process liquors, gases, trade wastes, sewage or sludge.**
- **Wall bracket, instrument panel, or floor mounting . . . outdoor or indoor as desired.**
- **Inclusion of three vital measuring elements—indicator, recorder, totalizer.**
- **Testing in place at any time with an easily applied manometer test device.**
- **Maximum differentials of 114" or 64" of water as desired.**
- **Easy flow reading, utilizing evenly spaced chart and dial graduations.**

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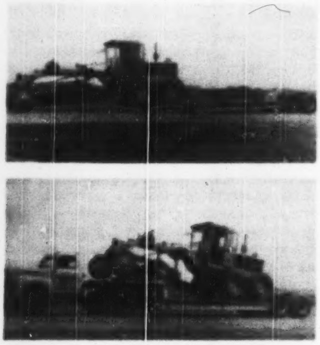
SIMPLEX

VALVE AND METER COMPANY

Equipment, Materials & Methods (Continued)

Folding Gooseneck Trailer

Another revolutionary development is a patented folding gooseneck trailer which, when lowered to the ground, forms a loading ramp. The need for heavy, cumbersome loading ramps and cribbing is completely eliminated by this combination gooseneck and loading ramp. Idle man and equipment hours are reduced to a minimum as a result of the simplicity of loading and unloading operations. This new method of front loading a "Carryhaul" trailer of low platform height provides greater clearance for viaducts, bridges and wires, allowing fast and safe movement between jobs. An additional feature of this trailer is the patented tandem axle assembly which is completely suspended in rubber for flexibility and independent wheel action. This trailer will be available in capacities up to 100 tons. **Martin Machine Co., Kewanee, Ill.**



Saves Man Hours

◆

Air Filtered Doors

An improved type of closure for paint-spray rooms and other work areas where air is subject to high spray or powder content has recently been added to the line of sectional, all metal RöL-TOP doors. The door features rows of standard, furnace type, spun-glass filters in each panel which permits a continuous supply of clean, fresh air to circulate into the room, even when the door is closed. Although filters are easily removed whenever replacement is necessary the original filters can be used indefinitely, without loss of efficiency, by simply "dry washing" them from time to time with the high pressure air hose. The doors are also equipped with several glass panels, for easy visibility. The air filter door features heavy-duty torsion-spring counterbalance, and operates on ball-bearing rollers moving in steel tracks that raise the door easily to a horizontal position overhead. It is available in any size, for manual or motor operation, and is designed for easy, low-cost installation. For complete information write to **Mr. W. D. Pearson, Kinnear Mfg. Co., Columbus 16, Ohio.**

Equipment, Materials & Methods (Continued)

Lift Truck

NATURAL GAS IS BEING piped to northern California from fields located 1,600 miles away in Texas and New Mexico. Total cost for this world's largest diameter natural gas pipe line will exceed $150,000,000. It is a project star-studded with new equipment and new engineering ideas. A Gerlinger lift truck with a specially engineered hydraulic grab arm was developed to load off-size, hard-to-handle 60-ft pipe sections on trailers and truck bolsters for hauling to the right-of-way. The truck, with its counter-active weight distribution and reserve power, proved to be more than a match for the 4-ton pipe sections. The hydraulic grab arm on the lift truck is designed to hold large and small circular material while traveling. There is positive hydraulic pressure on both the forks and the upper grab arm, making it possible to securely grip the load travel. Where the pipe is laying on the ground, the forks will dig in under as the grab arm comes down to lock the pipe for lifting. The grab arm can be raised and lowered by conveniently placed fingertip control. **Gerlinger Carrier Co., Dallas, Ore.**

◆

Arc Welder

THE LATEST ADDITION to Air Reduction's line of arc-welding machines is the 200-amp Hornet "Special" arc welder. This machine combines the compact 36A generator with a four-cylinder, 31 hp, air-cooled Wisconsin engine. The 36A generator, which has a welding range from 40 amp at 20 volts to 250 amp at 40 volts features a simplified current control, self-contained exciter and convenient terminals. The Hornet "Special" is 58½ in long, 25⅝ in wide, 47 in high and weighs 825 lb. It comes equipped with a full-length drip-proof canopy. A lifting eye is provided on top. Two-wheel, trailer-type running gear, with 4-ply pneumatic tires and a 38-in long drawbar, is available as optional equipment. **Air Reduction Sales Co., 60 E. 42nd St., New York, N.Y.**

◆

Self-Priming Jetting Pump

FOUR HUNDRED GAL PER MIN at 150 lb pressure and adapted for a host of uses is the new self-priming jetting pump. Contractors will welcome it for a solution to their pile driving jetting problems. Other uses include fire fighting, bank washing, hydraulicing, ponding, caisson work, watering down fills and pavements and mud pumping during drilling operations. This new pump is primed by engine exhaust, a device which primes the pump rapidly (naturally dependent upon the suction lift). High efficiency is a characteristic of this jetting pump, and self-priming device will not fail. For further information about the new Model HP 150 self-priming jetting pump and other jetting pumps, write **Sterling Machinery Corp., 405 Southwest Blvd., Kansas City 8, Mo.**

Have you seen the important

NEW FEATURES

on the WHITE Engineers' transit

YES, the White Engineers' Transit is a fine engineer's instrument — now made even finer with the addition of *covered leveling screws* and *coated optics*.

Covered leveling screws assure you of smooth, easy, precise leveling at all times, under all kinds of conditions for the life of the instrument itself.

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Compare the David White Engineers' Transit with all others—feature for feature — price for price. Compare them for accuracy — long durability — built-in quality. To meet your preference, this instrument is available with "U" or "A" type standards. You'll find you'll buy right when you buy a David White.

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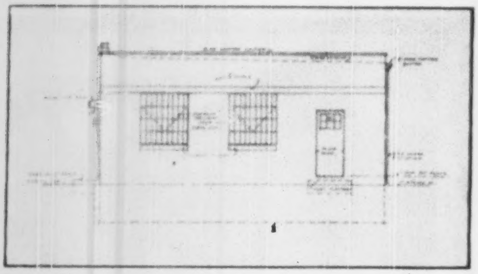
— the small extra first cost of test samples pays off in assurance of efficiency and durability of the finished structure.



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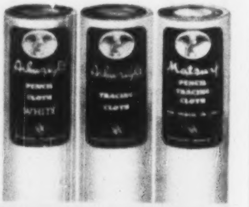

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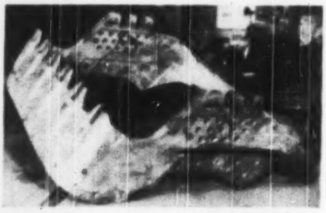
TRACING CLOTHS
AMERICA'S STANDARD FOR OVER 25 YEARS

Equipment Materials & Methods (Continued)

New Bucket Equipment

Many new design and material features in addition to the basic bucket pitch, taper and fairing necessary for fast digging, fast loading and clean dumping are claimed for the new Baer bucket. First deliveries from the company which was formed early last year cover a wide range of buckets, sizes and special-purpose shapes. Since starting production the company has been working full time and adding personnel to fill a growing backlog of orders for dragline, dipper and hoe buckets and replaceable teeth. The company is also operating a repair service for buckets, booms and allied construction equipment. All of Baer's Premium grade buckets as well as his new line of replaceable teeth are cast in Fibraloy, "the toughest steel known."



The normally vulnerable dragline bucket hitch-plate assembly has been strengthened in the Baer bucket by the use of Fibraloy and a new tongue and socket design that stiffens the whole front. Bucket rope sockets are made with a true circle design between socket and wedge. This maintains the rope at its full diameter at this point and greatly extends its life. Baer hoe buckets are manufactured in different widths for the same yardage to take trench cuts in solid material or loose gravel. The company is accepting orders for replaceable teeth for all makes of buckets and soliciting new inquiries for buckets of any size. **Baer Steel Products, Inc., Auburn, Washington.**

◆

Excavator

Production of a new 2-yard power shovel—the 51-B—has been announced. Convertible in the field for crane, dragline, clamshell or shovel service, the 51-B will meet the demands of general contractors and mine and quarry operators needing an all-purpose machine to turn out big yardages day in and day out. For dragline and clamshell service, booms from 50 to 90 ft in length are available. Crane booms may be purchased up to 110 ft in length. With a 60 ft boom at a 30-ft working radius, the 51-B will handle 28,000 lb. This rating is computed by taking 75% of the tipping load. Contractors may choose diesel or electric power. Main hoist, swing, boom hoist, crowd and retract machinery operate on anti-friction bearings. Detailed information about the 51-B may be obtained by writing the manufacturer, **Bucyrus-Erie Co., South Milwaukee, Wis.**

Equipment, Materials & Methods (Continued)

Force-Feed Loaders

In 1945, the State of North Carolina bought its first force-feed loader. Extensive tests were conducted on all types of loading work in connection with road maintenance. This single machine resulted in the purchase of four more loaders during 1946 to further extend the study of this equipment over a wider area. Today, the entire State road maintenance program will be considerably stepped-up by the use of these efficient loaders and many more miles of roadway will be maintained in better condition than was possible with former methods. This fleet of loaders will serve the State roadway departments on a year-round basis. The design of the machine makes it possible to load all types of windrow material including ditch trimmings, broken pavement, top soil, oil mix, gravel, leaves and snow. It is a self-propelled machine that travels under its own power, completely self-contained. **Athey Products Corp., Chicago, Ill.**

◆

Corrosive Liquids Feeder

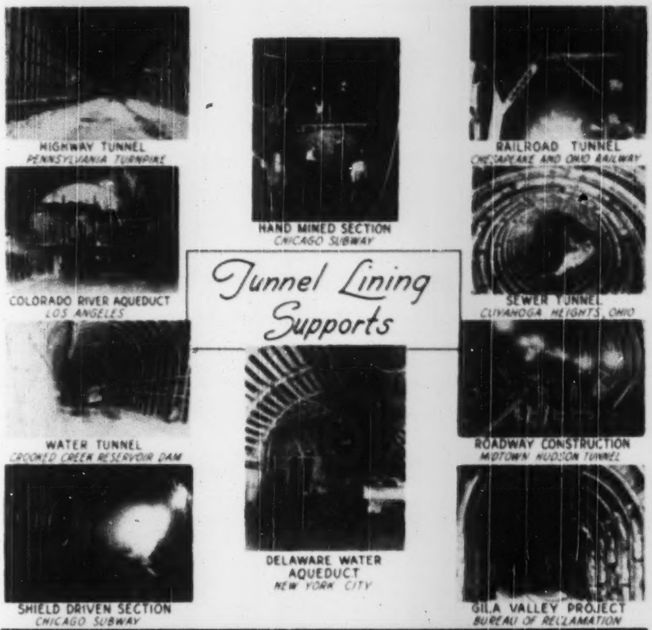
The Ferro-Feeder, an improved chemical proportioning pump to handle 35 to 40% ferric chloride solutions for sludge conditioning, has just been announced. All parts of the new unit coming in contact with the corrosive fluid are specially selected for corrosion resistance—the whipcord-reinforced diaphragm is of soft rubber, the reagent head and check valves are of hard rubber, and durable Hastelloy "D" is used for metal parts. While primarily designed for feeding ferric chloride, the Ferric-Feeder successfully handles other corrosive liquids such as hydrochloric acid, acid pickle liquors, etc. Capacity is large—up to one gal per min—and feeding rate is adjustable by a variable speed drive while the unit is operating. This new positive displacement pump delivers chemical at 20 psi pressure and assures accurate measurement of the liquid fed. **Proportioneers, Inc., Providence, R.I.**

◆

Compression Tester

Designed to enable the manufacturer of concrete blocks to run compression tests daily, this compact easily portable hydraulic press permits control over all of the variables which can effect the compressive strength of building units. Exerting a ram pressure of 175 tons, and equipped with a specially calibrated pressure gage for direct reading at a glance, the testing unit has dual manually operated pumps, one of which brings the platen into position quickly, and the other exerts crushing pressure very slowly in accordance with A.S.T.M. specifications. Thus two readings are available; one when the first sign of fracture appears, and the other at the point of ultimate destruction.

(Continued on page 102)



HIGHWAY TUNNEL
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CHICAGO SUBWAY

RAILROAD TUNNEL
CHESAPEAKE AND OHIO RAILWAY

COLORADO RIVER AQUEDUCT
LOS ANGELES

SEWER TUNNEL
CUYAHOGA HEIGHTS, OHIO

WATER TUNNEL
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LITERATURE ON REQUEST

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by W. E. Wickenden

("Whosoever shall compel thee to go one mile—
go with him twain.")

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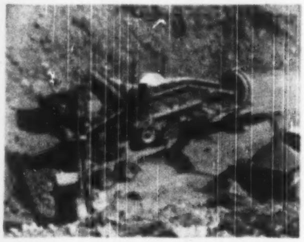
Equipment, Materials & Methods (Continued)

A leveling plate is provided on the table so that blocks can be easily checked for high spots, and the lower platen is self aligning in order to compensate for surfaces slightly off parallel. A high walled tray into which blocks are placed before testing, protects the operator in case of bursting or shattering which may occur when testing units other than concrete block, and effects easy and safe removal after destruction has occurred. **Forney's, Inc., 209 Elm St., New Castle, Pa.**

◆

"Rock-It" Plant

THE "ROCK-IT" CRUSHING and screening plant is a double-duty plant that will replace two single units. Designed specifically for the aglime, chip and road stone fields, the "Rock-It" produces crushed stone or aglime, or a percentage of both, in one operation. Capacities range from 60 to 80 tons per hr. Simple design and compact construction make the machine a highly portable plant. The only parts to remove to meet highway transportation requirements are the charging hopper and delivery conveyors.



60–80 Ton Capacity Per Hr.

Other features include accurate gradation of the finished product, centralized controls, low feeding height for shovel feed, and anti-friction construction throughout. Made up of standard Cedarapids units, the "Rock-It" plant consists of a 24-in. × 8-ft apron type feeder and charging hopper with grizzly; a newly designed roller bearing jaw crusher with a full 18-in. × 24-in. jaw opening and jaws of standard thickness; a 42" × 10' horizontal vibrating "aglime" screen; a Cedarapids hammer-mill, either 3033 or 2033; and a Cedarapids return wheel system of Monorail design. Bulletin RIP-1, containing complete details, dimensions and specifications, may be obtained from **Iowa Mfg. Co., Cedar Rapids, Iowa.**

◆

Power Units

WITH THE ADDITION OF three new 4 cylinder gasoline power units, the Models JX4C, JX4E and JX4D, to its line, Hercules Motors provides power users with a broader choice to more economically meet their specific power needs.

(Continued on page 103)

Equipment, Materials & Methods (Continued)

The power units are designed for high speed, heavy duty service in every industry where portable power can be used to advantage. The oil fields, mining industry, construction field, rock products industry, and agricultural industry will particularly find these three sizes indispensable in either of their open-, closed- or base-type mountings. Efficient and ample cooling are important in the successful operation of a power unit. Full-length water jackets are provided around each cylinder. Intake and exhaust valve passages are designed so that valve seats and stems are subject to maximum cooling. Thus, valve tappets remain in adjustment longer. **Hercules Motors Corp., Canton, Ohio.**

◆

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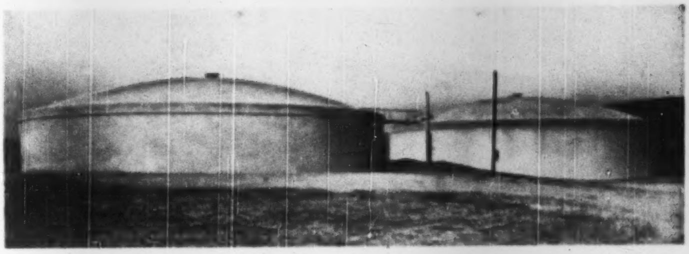
Trucks which have been built to handle cable reels have, for the most part, been adaptations of regular lift trucks making it necessary to adjust the lifting arrangement each time reels of different sizes were handled. A cable reel truck embodies an entirely new idea. Being designed for one specific purpose, this truck will handle reels of various diameters and widths without requiring any adjustment. The lifting arrangement incorporates two hydraulic hoists which raise the carrying arms of the truck. One of the popular standard models provides a 23-in. lift and will handle reels from 24 to 60 in. in dia. and up to 36 in. wide. The unit illustrated has a fifth wheel steer arrangement to provide maximum maneuverability. Ten-in. dia. wheels are fitted with Timken roller bearings. A single-speed hydraulic hand pump provides the power to elevate the lifting arms. Lowering is controlled by a finger tip release lever. **Lyon-Raymond Corp., 12963 Madison St., Greene, N.Y.**

◆

Half-Yard Shovel

Production has begun on an addition to the "Quick-Way" line of truck shovels and cranes. The model L is a $^1/_2$ cu yd power shovel, or ten ton capacity crane, equipped with heavy duty 30 ft folding type boom. With additional attachments the Model L is easily converted to trenchhoe, dragline or clamshell. Powered by an International U-9 motor developing 55 brake hp, the basic machine weighs 12,000 lb. For rapid clamshell operation, cable speeds are the same on both front and rear drums when lagging is used on the haulback drum. Standard equipment includes drum lagging, hold-in clutch levers with the same operational function as "snap-in" or "toggle-in" clutches, and a combination power trip and automatic tagline winder. 5, 10, and 20 ft boom extensions are available. **"Quick-Way" Truck Shovel Co., Denver, Colo.**



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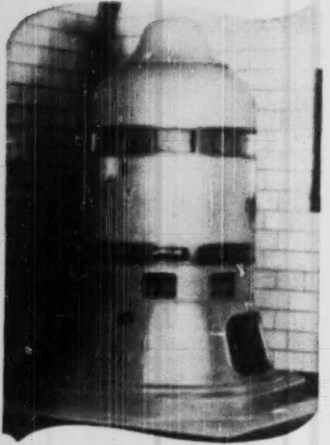

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Arc-Welding Accessories—A 20-page catalog, designated as publication GEC-253A, contains descriptions, specifications, and prices of more than 150 arc-welding accessories. Includes information on electrode holders, helmets, goggles, tungsten electrodes, etc. The products shown in the catalog will meet the requirements of all ordinary welding work, as well as many special applications. **General Electric Co., Schenectady 5, N.Y.**

Plastic Plywood—A 4-page bulletin describes and illustrates G.P.X., a plastic-faced plywood—the ideal material for reducing costs of concrete forms. Its smooth, glossy surface is practically impervious to moisture; highly abrasion-resistant and virtually eliminates checking and grain raise. **Georgia-Pacific Plywood & Lumber Co., Empire State Bldg., New York, N. Y.**

Breakers & Sheeting Drivers—A 6-page, 2-color bulletin, designated as H-1200-B40 describes Blue Brute paving breakers and sheeting drivers. This booklet lists the function of each tool and recommends how it may be used in specific construction jobs. These descriptions have been designed to give the construction man the best tool for each particular job. **Worthington Pump & Machinery Corp., Harrison, N.J.**

PC Glass Blocks—A booklet on PC glass blocks, containing general and technical data, illustrations, construction details and specifications, is offered to engineers, building contractors and owners. By dividing glass block patterns into decorative and functional groups and elaborating upon the specific advantages of each, this booklet makes it easier to select the correct pattern for job requirements. Copies of this 40-page booklet, "The Mark of a Modern Building—PC Glass Blocks," can be obtained free of charge. **Pittsburgh Corning Corp., 307 Fourth Ave., Pittsburgh 22, Pa.**

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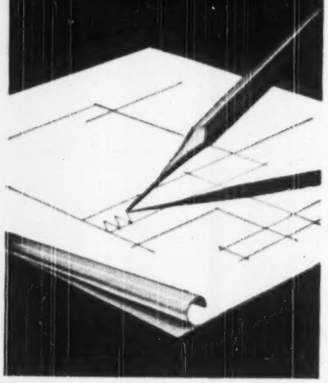

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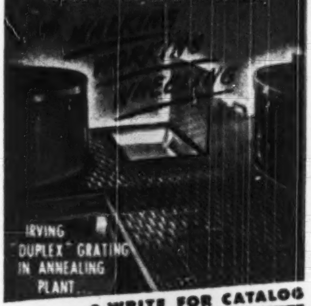
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BULLDOZERS—A variety of applications for bulldozers ranging from pushing 4-ton boulders out of the way to feeding crude salt to conveyors is presented in a new booklet. Product photographs accompany the 16 pages of information describing rocky hillside cutting, stripping work for quarries and mines, road construction and maintenance, land clearing, and river channel diversion. Write for Form 12172 entitled "What Caterpillar Bulldozers Can Do for You." **Caterpillar Tractor Co., Peoria 8, Ill.**

DIGESTER—A new, 2-color leaflet, "The Dorr Type MA Digester," contains a brief description of a new single-stage unit for sewage sludge digestion, and includes tables of sizes and design data. The digester is unique in that high-capacity mixing and gas storage are provided for the first time in a single-stage unit. The mixing feature is of particular interest, resulting in the positive elimination of scum formation, and promoting conditions most favorable to digestion and gas generation. **The Dorr Co., 570 Lexington Ave., New York 22, N.Y.**

DIESEL MOTOR GRADERS—If your job calls for road ditching, scarifying, bank shaping, snow plowing, oil mixing, or general road maintenance, then you will be interested in the 31-page booklet titled "Caterpillar Diesel Motor Graders." Provides excellent illustrations and data on various applications of the company's three models, the 100-hp No. 12, the 70-hp No. 112, and the 50-hp No. 212. Also included are engine cutaway pictures and close-up views of different parts and attachments on these units. Write for Form 11960. **Caterpillar Tractor Co., Peoria 8, Ill.**

WASTE TREATMENT—Manual No. 149 titled "Modern Processes and Equipment for Sewage and Industrial Waste Treatment" has just been published. It consolidates a wealth of information and experience into one concise yet comprehensive 24-page book that crystallizes the approach to modern waste treatment methods and equipment. The book graphically illustrates and describes processes and equipment. It includes the latest engineering developments from laboratories as well as those which have long been standard in large and small plants. **American Well Works, Aurora, Ill.**

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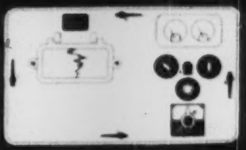

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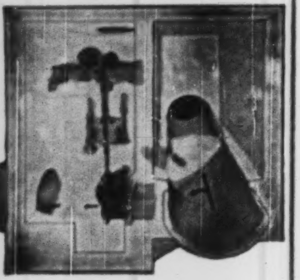

Fig. B-19

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Welding Equipment—Catalog No. 140 forms a comprehensive guide for the welder, covering every type of equipment necessary for all acetylene and oxygen operations. Containing over 150 illustrations, the text explains each item of equipment in detail and gives specific recommendations for its use. **Modern Engineering Co., Dept. 174, 3415 W. Pine Blvd., St. Louis 3, Mo.**

Water Conditioning—An 8-page bulletin explains the scope of Graver activities in the company's extensive laboratories and new pilot plant for research in water conditioning for boiler plant, process work, and general industrial and municipal use. The booklet illustrates some of the many large installations of hot-process and zeolite softeners, demineralizers, clarifiers, filters, etc. Ask for Bulletin WC-100. **Graver Water Conditioning Co., Dept. 162, 216 W. 14 St., New York 11, N.Y.**

Hydraulic Loader—Illustrated bulletin describes latest type hydraulic powered loader handling from $^3/_4$ yd standard material bucket up to 2-yd snow bucket with 180° swing. Attachments provide quick conversion to mobile yard or factory crane operating 14 to 23 ft booms, or to $^1/_4$-yd backhoe excavator. Complete with specifications. **Mandt Mfg. Co., 490 W. Goodale St., Columbus 8, Ohio.**

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Earthmovers—An action-photo review of crawler and wheel tractors in a wide variety of dirt moving operations is presented in an attractive 2-color pamphlet. Brief captions give work details and owner reports of tractor performance. Copies of the 12-page pamphlet, "International Power, Engineered for Efficient Earthmoving," are available on request. Ask for Form A-455-MM. **International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.**

Utility Ditcher—An 8-page color bulletin on the Buckeye Model 306 utility ditcher has recently been published. The new bulletin printed in coral and black emphasizes the many features in the Model 306 ditcher and lists the varied applications. Ask for Bulletin 306. **Gar Wood Industries, Inc., Findlay Div., Findlay, Ohio.**

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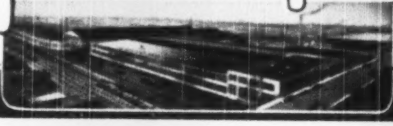

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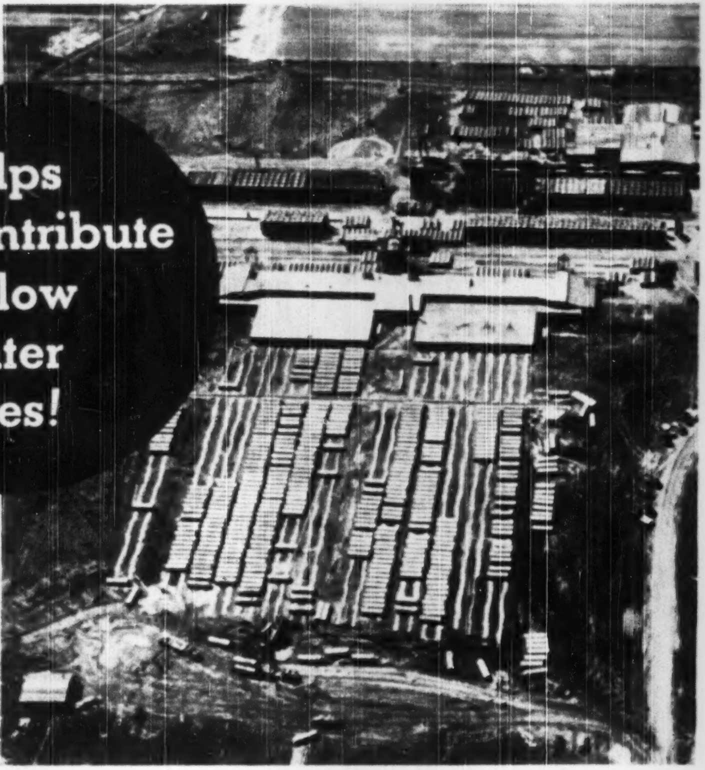

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